ARM-96-001

Site Scientific Mission Plan for the Southern Great Plains CART Site

January-June 1996

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NOTATION

ABRFC	Arkansas Basin Red River Forecast Center
ACAR	Aerodynamic Communication and Recording System
AERI	atmospherically emitted radiance interferometer
ANL	Argonne National Laboratory
AOS	aerosol observation system
ARESE	ARM Enhanced Shortwave Experiment
ARM	Atmospheric Radiation Measurement
AVHRR	advanced very-high-resolution radiometer
BBSS	balloon-borne sounding system
BLC	Belfort laser ceilometer
BSRN	Broadband Solar Radiation Network
CAR	Corrective Action Report
CART	Cloud and Radiation Testbed
CASES	Cooperative Atmosphere-Surface Exchange Study
CCN	cloud condensation nuclei
CIMMS	Cooperative Institute for Mesoscale Meteorological Studies
CSU	Colorado State University
DA	data assimilation
DMT	Data Management Team
DQR	Data Quality Report
DSIT	Data and Science Integration Team
EBBR	energy balance Bowen ratio
ECOR	eddy correlation
ETA	National Meteorological Center model
ETL	Environmental Technology Laboratory
EVAC	Environmental Verification and Analysis Center
FDDA	four-dimensional data assimilation
FTP	File Transfer Protocol
GBRS	Ground-Based Remote Sensing (IOP)
GCIP	GEWEX Continental-Scale International Project
GCM	general circulation model
GCSS	GEWEX Cloud System Study
GEWEX	Global Energy and Water Cycle Experiment
GIST	GEWEX Integrated System Test
GMS	general measurement strategy
GOES	geostationary orbiting Earth satellite
GPS	global positioning system
GSFC	Goddard Space Flight Center
GVaP	GEWEX Water Vapor Project
HD	hierarchical diagnosis
IDP	Instrument Development Program
IOP	Intensive Observation Period
IR	infrared

NOTATION (Cont.)

IRF	instantaneous radiative flux
IRT	infrared thermometer
ISLSCP	International Satellite Land-Surface Climatology Project
ISS	integrated sounding system
IT	Instrument Team
KSU	Kansas State University
LBL	line by line
LBLRTM	line-by-line radiative transfer model
MAPS	Mesoscale Analysis and Prediction System
MFR	multifilter radiometer
MFRSR	multifilter rotating shadowband radiometer
MPL	micropulse lidar
MSX	Midcourse Satellite Experiment
MWR	microwave radiometer
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCSU	North Carolina State University
NDVI	nondimensional vegetative index
NEPA	National Environmental Policy Act
NGM	nested grid model
NIP	normal-incidence pyrheliometer
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
NSSL	National Severe Storms Laboratory
NWS	National Weather Service
OCS	Oklahoma Climatological Survey
OKM	Oklahoma Mesonet
ORR	Operational Readiness Review
OU	University of Oklahoma
PAR	photosynthetically active radiometer
PARABOLA	portable apparatus for rapid acquisition of bidirectional observations of the land and the atmosphere
PARC	Palo Alto Research Center
PBL	planetary boundary layer
PBLF	Planetary Boundary Layer Facility
PC	personal computer
PIF	Problem Identification Form
PNNL	Pacific Northwest National Laboratory
PRB	Problem Review Board
PRR	Pre-Readiness Review
PSU	Pennsylvania State University
QME	quality measurement experiment

NOTATION (Cont.)

RASS	radio acoustic sounding system
RCF	radiometer calibration facility
RUCS	rapid update cycle
RWP	radar wind profiler
S	solar
SAC	Site Advisory Committee
SCM	single-column model
SDS	site data system
SGP	Southern Great Plains
SI	International System of Units
SIROS	solar and infrared radiation observing system
SMOS	surface meteorological observation station
SNL	Sandia National Laboratories
SORTI	solar radiance transmission interferometer
SOW	statement of work
SPM	site program manager
SST	Site Scientist Team
SUCCESS	Subsonic Aircraft: Contrail and Cloud Effects Special Study
SUNY	State University of New York
SWATS	soil water and temperature system
TBD	to be determined
TOA	top of atmosphere
UAV	unmanned aerospace vehicle
UM	University of Massachusetts
UNAVCO	University NAVSTAR Consortium
USAF	U.S. Air Force
UTC	universal time coordinated
UU	University of Utah
UV	ultraviolet
UW	University of Wisconsin
VAPs	Value-Added Products (Working Group)
VISSR	visible-IR spin-scan radiometer
VORTEX	Verification of the Origins of Rotation in Tornadoes Experiment
WPDN	Wind Profiler Demonstration Network
WPL	Wave Propagation Laboratory
WSI	whole-sky imager
WVMR	water vapor mixing ratio
2-D	two-dimensional
3-D	three-dimensional

SITE SCIENTIFIC MISSION PLAN
FOR THE SOUTHERN GREAT PLAINS CART SITE
JANUARY-JUNE 1996

1 INTRODUCTION

The Southern Great Plains (SGP) Cloud and Radiation Testbed (CART) site is designed to help satisfy the data needs of the Atmospheric Radiation Measurement (ARM) Program Science Team. This document defines the scientific priorities for site activities during the six months beginning on January 1, 1996, and looks forward in lesser detail to subsequent six-month periods. The primary purpose of this *Site Scientific Mission Plan* is to provide guidance for the development of plans for site operations. It also provides information on current plans to the ARM functional teams (Management Team, Data and Science Integration Team [DSIT], Operations Team, Instrument Team [IT], and Campaign Team) and serves to disseminate the plans more generally within the ARM Program and among the members of the Science Team. This document includes a description of the operational status of the site and the primary site activities envisioned, together with information concerning approved and proposed Intensive Observation Periods (IOPs). The primary users of this document are the site operator, the Site Scientist Team (SST), the Science Team through the ARM Program science director, the ARM Program Experiment Center, and the aforementioned ARM Program functional teams. This plan is a living document that is updated and reissued every six months as the observational facilities are developed, tested, and augmented and as priorities are adjusted in response to developments in scientific planning and understanding.

2 SUMMARY OF SCIENTIFIC GOALS

2.1 Programmatic Goals

The primary goal of the SGP CART site activities is to produce data adequate to support significant research addressing the objectives of the ARM Program. These overall objectives, as paraphrased from the *ARM Program Plan, 1990* (U.S. Department of Energy 1990), are the following:

- To describe the radiative energy flux profile of the clear and cloudy atmosphere

- To understand the processes determining the flux profile

- To parameterize the processes determining the flux profile for incorporation into general circulation models

To address these scientific issues, an empirical data set must be developed that includes observations of the evolution of the radiative state of the column of air over the central facility, as well as the processes that control that radiative state, in sufficient detail and quality to support the investigations proposed by the ARM Science Team. To address the entire 350-km × 400-km SGP CART site, ARM relies on models to compute the processes or properties that affect radiative transfer. This set of data includes measurements of radiative fluxes (solar and infrared [IR]) and the advective and surface fluxes of moisture, heat, and momentum occurring within the column and across its boundaries. Other entities to be described are cloud types, composition, and distribution (depth, fractional coverage, and layering); thermodynamic properties of the columnar air mass (temperature, pressure, and concentrations of all three phases of water); the state and characteristics of the underlying surface (the lower boundary condition); processes within the column that create or modify all of these characteristics (including precipitation, evaporation, and the generation of condensation nuclei); and radiatively significant particles, aerosols, and gases. Basic continuous observations must be made as often as is feasible within budgetary constraints. For limited periods of time, these observations will be supplemented by directed IOPs providing higher-resolution or difficult-to-obtain *in situ* data.

Beyond simply providing the data streams, determining their character and quality as early as possible in the observational program is imperative. This evaluation will provide the basic operational understanding of the data necessary for an ongoing program of such scope. Although both reason and ample opportunity will exist to develop a further understanding of the ARM observations over the course of the program, the task of investigating and ensuring the data quality as soon as possible is important. In this regard, early and definitive quality measurement experiments (QMEs) will establish confidence in the measurements.

The SGP CART site is the first of several global locations chosen and instrumented for data collection. As summarized in a draft report by Sisterson and Barr, the scientific issues to be addressed by using data from a midlatitude continental CART observatory include the following:

- Radiative transfer in cloudless, partly cloudy, and overcast conditions

- Cloud formation, maintenance, and dissipation

- Nonradiative flux parameterizations

- The role of surface physical and vegetative properties in the column energy balance

- Other complications in the radiative balance in the atmosphere, particularly those due to aerosols, cloud condensation nuclei (CCN), and cloud-aerosol radiative interactions

- Feedback processes between different phenomena and different domains

The variety, surface density, and atmospheric volumetric coverage of the SGP instrumentation will be more comprehensive than that at any other ARM site, and the SGP site will experience a wider variety of atmospheric conditions than will any other ARM site. The resulting data will accordingly support a greater range and depth of scientific investigation than data from any other location, making it imperative for the ARM Program to develop and maintain a high-quality, continuous data stream from the SGP site.

The measurements required by Science Team proposals, the DSIT, and the science director have in the past been incorporated into a set of general measurement strategies (GMSs) representing groups of experiments requiring measurements with similar characteristics. The initial GMSs were originally designed to quantify the instantaneous radiative flux (IRF) and to support the requirements of the single-column model (SCM), data assimilation (DA), and hierarchical diagnosis (HD) research. The DSIT and other teams coordinated activities to develop integrated, well-focused data sets. During this six-month period, the ARM Program will begin moving toward a new paradigm that will reorganize the DSIT around geophysically significant phenomena (e.g., water vapor profiles, aerosols, clouds, temperature profiles, radiation) rather than GMSs. The intent is to shift toward algorithm development that prescribes these geophysical phenomena as products rather than focusing on individual data streams. This transition is addressed in more detail in Section 5.5.

2.2 Priorities for Site Activities

The primary scientific goal has shifted from the establishment of routine observations to addressing the specific science issues related to the SGP CART site. In descending order, we rank the priorities of site activities for January through June 1996 as follows:

1. Plan and implement key IOPs.

2. Plan and implement campaigns.

3. Support all data quality assurance efforts, including implementation of QMEs.

4. Complete establishment and sustain high quality of routine site operations.

5. Support the Instrument Development Program (IDP).

Within this ranking, the differences in relative importance between adjacent items are not large. The categorization is also somewhat artificial, because many site activities are multipurpose. For example, IOP activities can simultaneously support Science Team, IDP, and campaign requirements. Even so, this ranking reflects our scientific assessment of the activities that should receive the most support during this period.

The IOPs will focus on providing critical data sets on an episodic basis to the Science Team, as well as field support for instrument development and testing and for collaborative campaigns. The IOPs scheduled for this six-month period are detailed in Section 5. To assist the site scientist with scientific issues, a Site Advisory Committee (SAC) was formed, consisting of seven scientists, approximately half from outside the ARM Program, to provide scientific guidance for the SGP CART site. The SAC works with the site scientist and the site program manager. The report from their first on-site meeting (November 27-29, 1995) will become available during this six-month period.

Budgetary constraints and site scientific issues have forced management of the SGP CART site to continually reevaluate the radiosonde launch schedule. The cost of radiosondes is the single largest expense for the SGP CART site. Routine radiosonde observations will continue to include five daily balloon-borne sounding system (BBSS) launches on Monday through Friday (including holidays) at the central facility. One routine daily launch will continue on Monday through Friday (including holidays) at the four boundary facilities. Three SCM IOPs, each lasting for three weeks, are now conducted each year; a spring SCM IOP is scheduled for April 1996. Three SCM IOPs will continue to be scheduled each year. Spring and summer SCM IOPs are scheduled annually, while fall and winter SCM IOPs alternate between years. Because a fall SCM IOP occurred in 1995 to support the ARM Enhanced Shortwave Experiment (ARESE) IOP, and because of budget constraints, a winter SCM IOP that had been scheduled for January 1996 was canceled.

Although more instrumentation will be added, the SGP site central facility and boundary facilities are nearly complete, and routine operations have been established for most platforms. The emphasis in this six-month period will be on completing the installation of the remaining three extended facilities and implementing one auxiliary and three intermediate facilities.

Although budgetary limitations have somewhat slowed the development and completion of the site, 18 permanent extended facilities are in place. Activities to develop boundary facilities will be limited to establishing permanency (i.e., installation of T-1 lines [dedicated, high-speed, serial data transmission lines] and support trailers) and will result in the completion of those facilities by April 1996. At the central facility, the aerosol facility has been installed, and calibration facility construction will begin in early January 1996. Establishment of one auxiliary facility will be needed to accommodate the installation of a second day-night whole-sky imager (WSI). The IDP instruments expected to be accepted as CART instruments during this period are an atmospherically emitted radiance interferometer (AERI X), a solar radiance transmission interferometer (SORTI 02), and the micropulse lidar (MPL 02). The IDP millimeter cloud radar is expected to become a CART instrument during spring 1996.

All current (and future) solar and infrared radiation observing systems (SIROSs) have been upgraded with SciTec solar tracking and shading assemblies. These will improve measurements of the direct and diffuse broadband solar radiation and the diffuse hemispheric broadband infrared radiation, which are important elements in the IRF measurements. Deployment of SIROS at the remaining extended facilities is dependent on the availability of broadband radiometers. As in the case of SIROS, installation of eddy correlation (ECOR) instruments is dependent on availability from the vendor. However, the physical infrastructure at all extended facilities will be completed during this period, probably before instrument deployment. The central facility Broadband Solar Radiation Network (BSRN) will also be upgraded with a SciTec assembly in January 1996.

During this six-month period, we will address additional SCM, DA, and HD boundary layer measurement needs with the procurement of three 915-MHz profilers with radio acoustic sounding systems (RASSs). These instruments will be deployed at locations between the central and boundary facilities to enhance the boundary layer monitoring across the total SGP CART site. This deployment will require additional leasing of property and environmental assessments at the new locations, which will be referred to as "intermediate facilities."

A unique opportunity to supplement the existing CART instrumentation was proposed by the SST and has been funded by the GEWEX Continental-Scale International Project (GCIP), housed within the National Oceanic and Atmospheric Administration (NOAA) Office of Global Programs. (GEWEX is the Global Energy and Water Cycle Experiment.) This support will permit additional sensors for profiling of soil moisture and temperature to be installed at the central facility and the extended facilities during this period, with the network being completed by the spring of 1997. These additional sensors will support water and energy budget analyses, diagnostic studies, and model validation efforts of ARM and GCIP investigators. Installation is planned to begin in January 1996 and to continue through the remainder of this six-month period.

During IOPs, site operations staff will continue to support activities necessary for the IDP. Remaining IDP-related efforts will be dedicated to configuring systems for permanent deployment at the CART site and evaluating a few remaining instruments in need of field verification (e.g., Raman lidar, millimeter cloud radar). These activities will occur during the next six months.

In summary, our goals for this six-month period are to provide the Science Team with a suite of measurements that will support a wide range of research, to establish solid procedures for instrument calibration and maintenance, and to continue the series of QMEs. Quality assurance efforts are central to the success of the entire program. A new section (Section 4) has been added to this report to reflect this increasing emphasis.

3 ROUTINE SITE OPERATIONS

3.1 Overview

The overwhelming majority of the measurements with the highest priority, on which the existing experimental designs are based, are regular (i.e., routine) observations, as specified in the *ARM Program Plan, 1990* (U.S. Department of Energy 1990). Scientifically and logistically, routine operations will also serve as the basis and background for all nonroutine operations, including instrument development activities, IOPs, and collaborative campaigns directed toward obtaining difficult-to-gather or expensive *in situ* data. Consequently, development and validation of the basic observations remain high priorities. Site development has progressed sufficiently to support three IOPs addressing key scientific questions during this six-month period. In addition, the IOPs are an opportunity to provide more focused data sets to the Science Team and the scientific community at large.

The SST will continue to work to ensure the scientific productivity of the site by providing guidance to the site operations manager and his staff on scientific matters related to the data stream, by answering questions from operations personnel concerning potential instrument problems, by reviewing schedules and procedures for instrument maintenance and calibration, by reviewing designs for infrastructure supporting new instruments, by contributing to the design of the standard operating procedures, by reviewing and developing plans for special operations, and by helping to obtain additional weather forecasting support for special operations. The SST, in cooperation with instrument mentors and others, will continue to contribute to the data quality control effort at the CART site, an ongoing activity that includes monitoring of the CART data streams in collaboration with the staff at the central facility, and to the development of quality assurance tools that will address the data originating at the SGP site. These activities are discussed in more detail in Section 4 of this report.

By the end of this period, development of the SGP CART site will be nearly complete, except for the wooded extended facility. Routine operations are considered to be the activities related to the operation and maintenance of instruments, the gathering and delivery of the resulting data, and the planning for scientific investigations, including IOPs, campaigns, and QMEs. Although the site is nearly complete, instrumentation will be evaluated continuously to assess the need for possible elimination of instruments or replacement with updated or new sensors. The process that leads to implementation of CART instruments continues to be the Pre-Readiness Review (PRR). The PRR includes the identification of requirements for instrument design and installation and the development of the documentation, procedures, and training needed to maintain CART instrumentation and integrate data streams into the site data system. The PRR also provides a forecast of when these instruments will be fully operational and delivering data to the Experiment Center and the Archive.

The expectation for routine operation of instruments is that they will require servicing by site operators only once every two weeks. If an instrument failed during a two-week period at an extended facility, data streams could be lost, by design. Such loss of data is acceptable to the ARM Program. The data collected at all extended and boundary facilities by the end of this period are expected to be polled frequently each day by the site data system at the central facility, then packaged and delivered to the Experiment Center and the Archive once daily. The Experiment Center generally delivers data to Science Team members and other data requesters once weekly.

Site operations staff proposed an instrument triage plan during the spring of 1995 for IOPs and campaigns. The plan called for identifying instruments, individual sensors, and communication links in need of more frequent servicing than the routine operation requirements mentioned above. The priority of triage efforts was determined by the SST, which took into consideration the importance of a particular data stream to the success of the scientific investigation(s). The triage plan has been very successful, as demonstrated during the ARESE IOP, and it will be an ongoing effort during the upcoming six months.

Handling of instruments that must be returned to the vendor for calibration and servicing is also part of routine operation. Replacement instruments and sensors will be rotated regularly to meet these requirements. A comprehensive, integrated plan for calibration and maintenance is being compiled by the SST in conjunction with the site operations manager and instrument mentors; this work will continue during this six-month period. Changeouts of all sensors and instrumentation are recorded in the site operations log.

The initial checks on data quality after instrument installation are provided by the instrument mentors. After the mentor reviews the data stream to ensure that the acquired instrument is performing properly and that the data are identified accurately by the Experiment Center, the mentor approves a "beta" release. The beta release provides data to selected Science Team members who have requested them and are willing to work with the instrument mentor on data quality issues. Beta releases are established after the instrument mentor and an appropriate member of the DSIT create a general statement on data quality for the Experiment Center. Beta releases are also available to other Science Team members who are willing to work in conjunction with the instrument mentor. When the data quality is consistently acceptable and well documented, the mentor approves a "full" release of the data.

3.2 Routine Operations

3.2.1 Functional Instruments and Observational Systems

Accomplishments in the area of site development are most evident at the central facility, with its functioning power, fiber-optic infrastructure, and near-complete array of instruments. Of the 26 planned extended facilities, 20 (including 1 at the central facility and 1 at the Cement location) are operational at the beginning of this period, 3 (Halstead, Seminole, and Ft. Cobb) are expected to be operational by the end of this six-month period, 1 (Okmulgee, the wooded location) is to be developed when sufficient funds become available, and 2 are placeholder sites for possible expansion, if required. "Operational" means that the instruments are installed and collecting data, but the data collection may not yet be fully automated. If the data are not ingested, data are downloaded every two weeks onto laptop computers by site operators and transported back to the central facility for transmittal to the Experiment Center.

Four boundary facilities are also in operation. Data are currently transferred from the boundary facilities by overnight express service to the central facility for data ingestion; however, T-1 lines are planned for installation at all boundary facilities by April 1996. Figure 1 is a map of the SGP site showing the locations of the developed extended and boundary facilities. The status of the systems and instruments anticipated by June 30, 1996, is summarized in Tables 1 and 2.

3.2.2 Launch Schedule for Balloon-Borne Sounding Systems

Until the full suite of remote sensing systems is deployed to perform deep, detailed soundings of the wind, temperature, and moisture of the troposphere under a wide range of conditions, the BBSS will continue to be an expensive workhorse because of the cost of the expendables and manpower associated with an ambitious schedule of radiosonde launches. The number of BBSS launches sitewide should eventually be reduced to a minimum needed to support routine cross-checks on the remotely sensed measurements, but we are a number of years from that goal. The frequency of routine launches at the central facility during this six-month period will be the same as in the previous six months. Routine operations (see Table 3) will

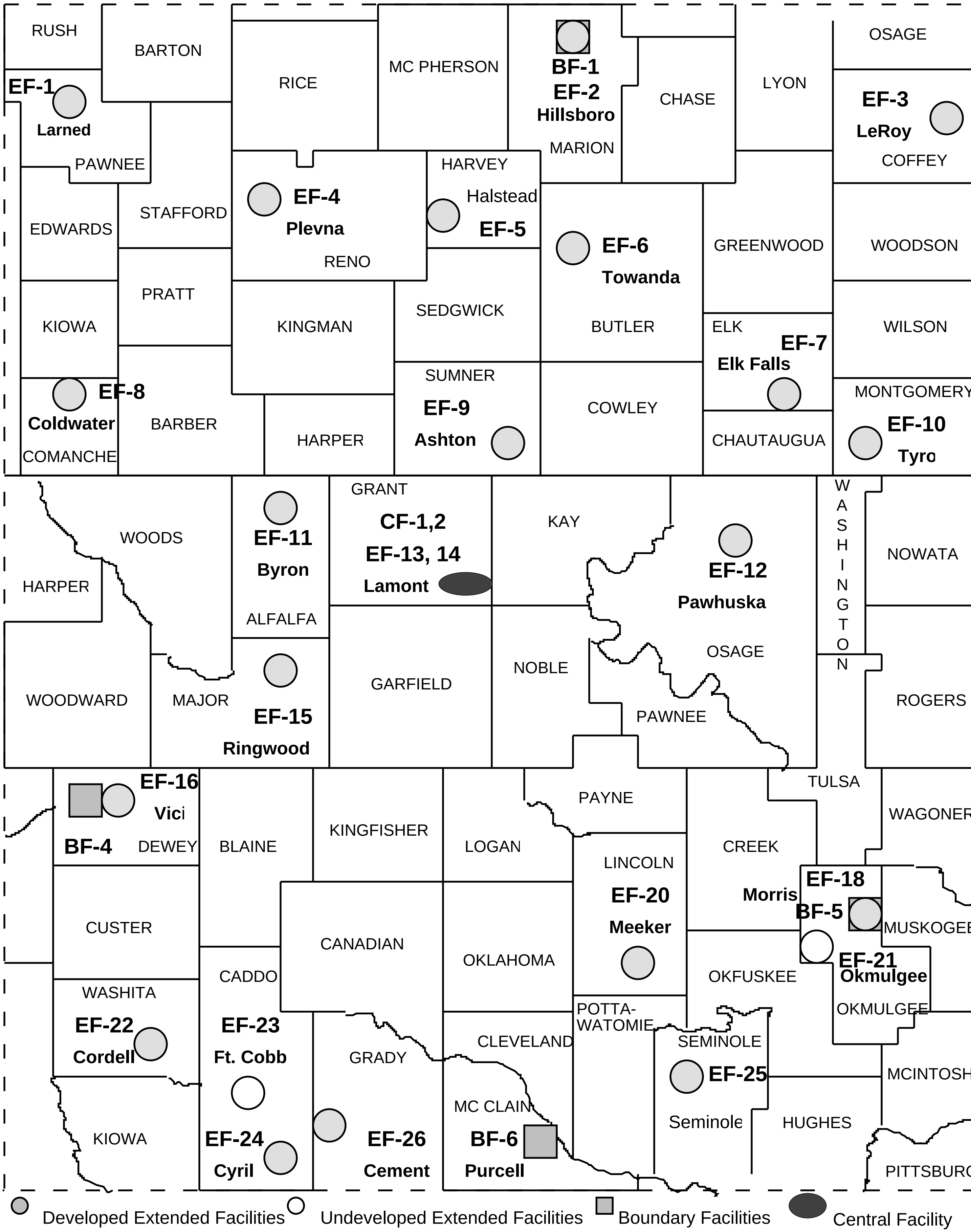

FIGURE 1 Overall View of the SGP CART Site (Scale: 50 km/in.)

TABLE 1 Locations and Status of Extended Facilities[a]

Site	Elevation[b] (m)	Latitude, Longitude (deg)	Surface Type	Flux Station[c]	SMOS[c]	SIROS[c]	Comment
Larned, KS EF-1	632	38.202 N 99.316 W	Wheat	ECOR 9/1/95	Yes 9/1/95	Yes 9/1/95	Power and communication center installed October 1995
Hillsboro, KS EF-2	450	38.306 N 97.301 W	Pasture	EBBR 6/96	No	Yes 9/7/95	Power and communication center installed August 1995
LeRoy, KS EF-3	338	38.201 N 95.597 W	Wheat and soybeans (rotated)	ECOR 12/7/95	Yes 12/7/95	Yes 12/7/95	Power and communication center installed September 1995
Plevna, KS EF-4	513	37.953 N 98.329 W	Rangeland (ungrazed)	EBBR 4/4/93	Yes 3/28/95	Yes 3/28/95	Power and communication center installed March 1995
Halstead, KS EF-5	—	—	Wheat	ECOR 2/96	SMOS 2/96	SIROS 2/96	Power and communication center installed November 1995
Towanda, KS EF-6	409	37.842 N 97.020 W	Alfalfa	ECOR 12/14/95	Yes 12/14/95	Yes 12/14/95	Power and communication center installed August 1995
Elk Falls, KS EF-7	283	37.383 N 96.180 W	Pasture	EBBR 9/8/93	Yes 3/9/95	Yes 3/9/95	Power and communication center installed February 1995
Coldwater, KS EF-8	664	37.333 N 99.309 W	Rangeland (grazed)	EBBR 12/8/92	Yes 3/4/93	Yes 5/9/95	Power and communication center installed May 1995
Ashton, KS EF-9	386	37.133 N 97.266 W	Pasture	EBBR 12/10/92	Yes 3/13/90	Yes 10/5/93	Power and communication center installed October 1993
Tyro, KS EF-10	248	37.068 N 95.788 W	Wheat	ECOR 7/21/95	Yes 7/21/95	Yes 7/21/95	Power and communication center installed June 1995
Byron, OK EF-11	360	36.881 N 98.285 W	Alfalfa	ECOR 6/26/95	Yes 6/26/95	Yes 6/26/95	Power and communication center installed June 1995
Pawhuska, OK EF-12	331	36.841 N 96.427 W	Native prairie	EBBR 9/11/93	None	Yes 6/30/95	Power and communication center installed June 1995

TABLE 1 (Cont.)

Site	Elevation[b] (m)	Latitude, Longitude (deg)	Surface Type	Flux Station[c]	SMOS[c]	SIROS[c]	Comment
Lamont, OK EF-13, 14	318	36.605 N 97.485 W	Pasture, wheat	EBBR 8/24/92 ECOR 5/30/95	Yes 4/9/93	Yes 10/15/93 BSRN 5/15/92	Power and communication center installed June 1993
Ringwood, OK EF-15	418	36.431 N 98.284 W	Pasture	EBBR 9/25/92	Yes 3/29/93	Yes 10/12/93	Power and communication center installed October 1993
Vici, OK EF-16	602	36.061 N 99.134 W	Wheat	ECOR 5/30/95	No	Yes 5/30/95	Power and communication center installed May 1995
EF-17	—	Unspecified	—	—	—	—	—
Morris, OK EF-18	217	35.687 N 97.856 W	Pasture (ungrazed)	EBBR 6/96	No 1/96	es 1/96	Power and communication center installed October 1995
EF-19	—	Unspecified	—	—	—	—	—
Meeker, OK EF-20	309	35.564 N 96.988 W	Pasture	EBBR 4/3/93	Yes 4/2/93	Yes	Power and communication center installed October 1994
Okmulgee, OK EF-21	—	Location identified	Forest	ECOR	Yes	Yes	No lease agreement
Cordell, OK EF-22	465	35.354 N 98.977 W	Rangeland (grazed)	EBBR 4/4/93	No	Yes 4/26/95	Power and communication center installed March 1995
Ft. Cobb, OK EF-23	415	35.153 N 98.461 W	Peanuts (irrigated)	ECOR	No	Yes	No lease agreement
Cyril, OK EF-24	409	34.883 N 98.205 W	Wheat (gypsum hill)	ECOR 8/25/95	Yes 8/25/95	Yes 8/25/95	Power and communication center installed July 1995
Seminole, OK EF-25	—	—	Pasture	EBBR 6/96	Yes	Yes	No lease agreement

TABLE 1 (Cont.)

Site	Elevation[b] (m)	Latitude, Longitude (deg)	Surface Type	Flux Station[c]	SMOS[c]	SIROS[c]	Comment
Cement, OK EF-26	400	34.957 N 98.076 W	Pasture	EBBR 9/20/92	No	No	Phone line (only) installed October 1992

[a] BSRN, Broadband Solar Radiation Network; EBBR, energy balance Bowen ratio; ECOR, eddy correlation; SIROS, solar and infrared radiation observing system; SMOS, surface meteorological observation station.

[b] Above sea level.

[c] Date indicates actual or scheduled installation date.

TABLE 2 Instruments and Observational Systems in Place at the Central, Boundary, Extended, and Auxiliary Facilities on June 30, 1996[a]

Central Facility

Radiometric Observations

- AERI
- AERI X
- SORTI
- BSRN
    - Pyranometer (ventilated)
    - Pyranometer (ventilated, shaded)
    - Pyrgeometer (ventilated, shaded)
    - NIP on tracker
    - MFRSR
- SIROS
    - Pyranometer (ventilated)
    - Pyranometer (ventilated, shaded)
    - Pyrgeometer (ventilated, shaded)
    - NIP on tracker
    - MFRSR
    - Pyranometer (upwelling, above pasture at 10 m)
    - Pyrgeometer (upwelling, above pasture at 10 m)
- UV-B
- PAR
- MFR (upwelling, above pasture at 10 m)
- Pyranometer (upwelling, above wheat at 25 m on 60-m tower)
- Pyrgeometer (upwelling, above wheat at 25 m on 60-m tower)
- MFR (upwelling, above wheat at 25 m on 60-m tower)

Wind, Temperature, and Humidity Sounding Systems

- BBSS
- 915-MHz profiler with RASS
- 50-MHz profiler with RASS
- MWR
- Heimann IR thermometer
- Raman lidar

Cloud Observations

- WSI (daytime/nighttime)
- BLC (interim)
- MPL (IDP) ceilometer
- Millimeter cloud radar

Others

- Temperature and humidity probes at 25-m and 60-m levels on tower
- EBBR
- ECOR
- SMOS
- AOS (samples at 10 m)

TABLE 2 (Cont.)

Extended Facility Components

- SIROS
  - Pyranometer (ventilated)
  - Pyranometer (ventilated, shaded)
  - Pyrgeometer (ventilated, shaded)
  - NIP on tracker
  - MFRSR
  - Pyranometer (upwelling, at 10 m)
  - Pyrgeometer (upwelling, at 10 m)
- EBBR or ECOR
- SMOS
- SWATS

Auxiliary Facilities

- None in preparation

Boundary Facilities

- BBSS
- MWR

Intermediate Facilities

- 915-MHz profiler and RASS

[a] AERI, atmospherically emitted radiance interferometer; AOS, aerosol observation station; BBSS, balloon-borne sounding system; BLC, Belfort laser ceilometer; BSRN, Broadband Solar Radiation Network; EBBR, energy balance Bowen ratio; ECOR, eddy correlation; IDP, Instrument Development Program; IR, infrared; MFR, multifilter radiometer; MFRSR, multifilter rotating shadowband radiometer; MPL, micropulse lidar; MWR, microwave radiometer; NIP, normal-incidence pyrheliometer; PAR, photosynthetically active radiometer; RASS, radio acoustic sounding system; SIROS, solar and infrared radiation observing system; SMOS, surface meteorological observation station; SORTI, solar radiance transmission interferometer; SWATS, soil water and temperature system; UV-B, ultraviolet-beta radiation; WSI, whole-sky imager.

TABLE 3 Radiosonde Launch Schedule for January 1-June 30, 1996 (Times in UTC)[a]

Central Facility	Boundary Facilities
Routine Operations, January 1-April 12, Monday-Friday	
0600	
1200	
1500	1800
1800	
2100	
SCM IOP Operations, April 15-May 5, Monday-Sunday	
0300	0300
0600	0600
0900	0900
1200	1200
1500	1500
1800	1800
2100	2100
2400	2400
Routine Operations, May 6-June 30, Monday-Friday	
0600	
1200	
1500	1800
1800	
2100	

[a] UTC, universal time coordinated. Launch time is 30 min earlier; the stated time represents the approximate midpoint of the flight.

include five daily launches at the central facility and one daily launch at each of the four boundary facilities.

The current routine launch times at the central facility were chosen to facilitate IRF and IDP research, and the launch times at the boundary facilities were chosen to support the microwave radiometer (MWR) and the nearby NOAA 404-MHz profilers with further RASS deployment and to complement the wider network of National Weather Service (NWS) launches. Remote sensing of virtual temperature profiles at all boundary facilities is provided by the nearby NOAA profilers, which are being outfitted with ARM-provided RASS units. RASS units have already been installed at the Purcell, Oklahoma, and at the Haviland, Kansas, NOAA profilers. The Lamont, Oklahoma, NOAA profiler will not receive a RASS unit, because it would be located too close to a residence. The profilers located at Vici and Morris, Oklahoma, and Hillsboro, Kansas, are expected to be installed during this six-month period. In addition, global positioning systems (GPS) instruments have been installed at the NOAA Purcell, Vici, Morris, and Hillsboro locations to provide estimates of precipitable water. This information is expected to become available to the ARM Program during this period as external data, along with the NOAA profiler data.

The four boundary facilities routinely launch radiosondes once daily at 1800 universal time coordinated or noon local time. Boundary facilities will be staffed only during the period of 1030-1430 local time, Monday through Friday (including holidays). During IOPs, the boundary facilities will be staffed 24 hours per day for 21 consecutive days (including holidays) to facilitate releases every 3 hours (Table 3).

The central facility will be staffed from 0430 to 1630 and from 2230 to 0230 local time, Monday through Friday (including holidays). During IOPs, the central facility will be staffed 24 hours per day, 7 days per week (including holidays) to facilitate round-the-clock releases every 3 hours.

3.3 Instruments

A CART instrument is any instrument that is approved by the ARM Program and for which the site operations management has accepted responsibility for operation and maintenance. The Pre-Readiness Review (PRR) and Operational Readiness Review (ORR) forms are requests for information that facilitates the installation and operation of instruments or facilities at the SGP CART site. The purpose of these reviews is to achieve an efficient handoff of instruments and facilities from instrument mentors to site operators. Figure 2, the SGP CART instrumentation implementation flow chart, contains information obtained from the PRR and ORR documentation. When all procedures, operation manuals, and training pertaining to an instrument have been completed, the instrument is accepted by the site operations management. If sufficient documentation is available to operate an instrument, even though more will ultimately be required for full acceptance, the instrument may be operated in a degraded mode. The status of the instruments is summarized in Table 4.

Construction of the aerosol trailer was completed in November 1995. Equipment includes an optical particle counter (0.1-10 μm); an integrating nephelometer for three

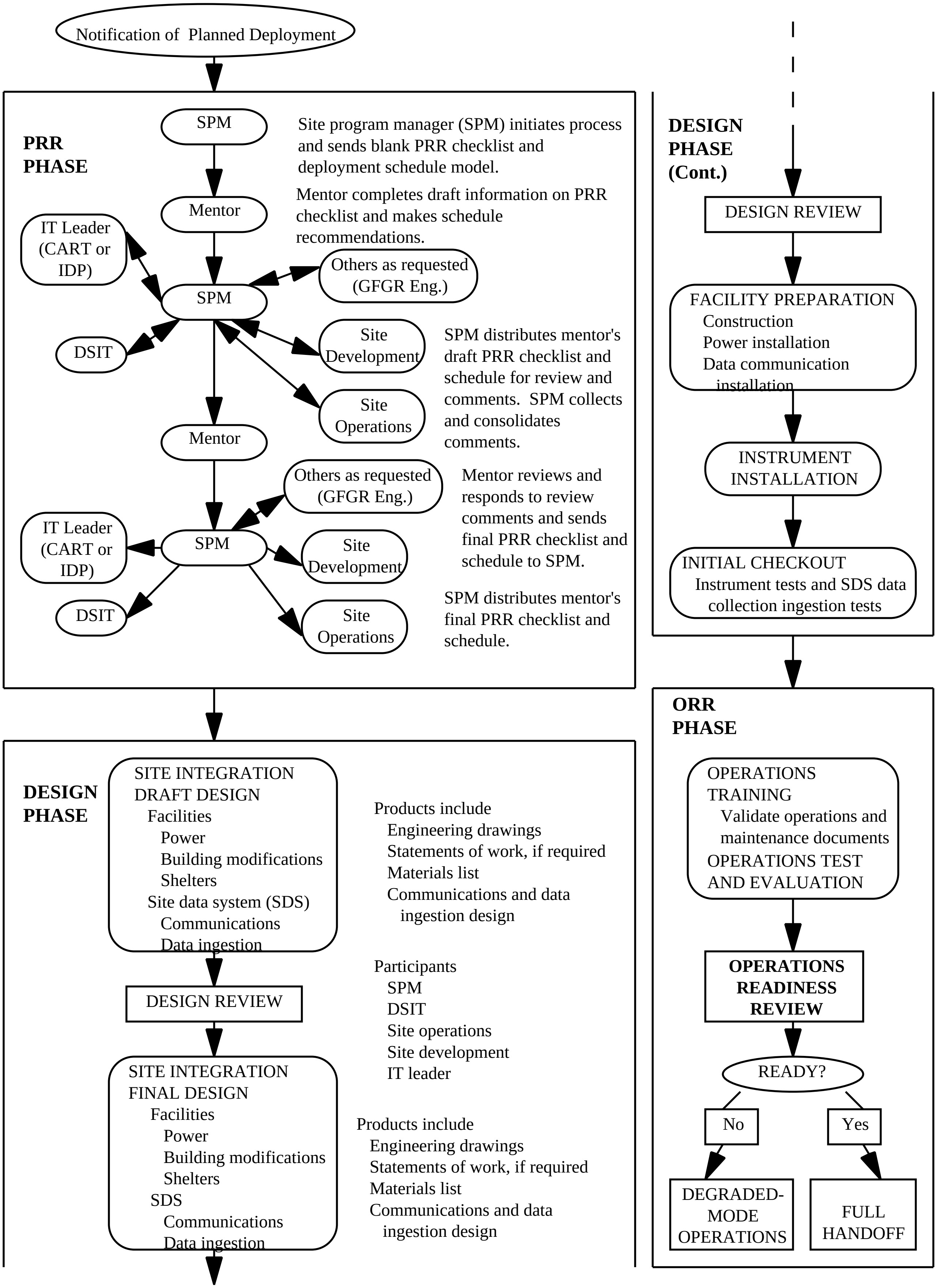

FIGURE 2 SGP CART Instrumentation Implementation Flow Chart

TABLE 4 Status of SGP CART Instrumentation by December 31, 1995[a]

Instrument System	Instrument Class	Installation Date	ORR Date	Full Handoff	Degraded Operations
BBSS PC Cora	CART	3/15/92	1/27/93	Yes	—
MWR	CART	11/2/92	5/17/95	Yes	—
EBBR	CART	11/24/92	11/24/92	Yes	—
SORTI 00	IDP	1/15/93	1/15/93	No	Yes
915-MHz profiler and RASS	CART	1/30/93	1/30/93	Yes	—
BLC	CART	3/15/93	5/19/95	Yes	—
BBSS Digi-Cora	CART	3/15/93	4/15/93	Yes	—
AERI 00	IDP prototype	3/18/93	3/18/93	No	Removed 7/95
SMOS	CART	6/10/93	6/10/93	Yes	—
SIROS	CART	9/15/93	5/17/95	Yes	—
MPL 00	IDP prototype	9/15/93	5/22/95	No	Scheduled removal 1/96
25-m upwelling IR/S radiometer	CART	9/15/93	5/22/95	Yes	—
25-m MFR	CART	9/15/93	5/22/95	Yes	—
10-m MFR	CART	9/15/93	5/22/95	Yes	—
WSI 00	IDP loaner	10/18/93	5/22/95	No	Removed 9/95
50-MHz Profiler with RASS	CART	1/30/94	1/30/94	Yes	—
C3 (mobile system) ECOR	CART	3/15/95	10/12/95	No	No
AERI 01	CART	4/22/95	5/17/95	No	No (preliminary documents received 12/95)

TABLE 4 (Cont.)

Instrument System	Instrument Class	Installation Date	ORR Date	Full Handoff	Degraded Operations
C2 (3-m tower) ECOR	CART	5/16/95	5/18/95	No	Yes
MPL 02	CART	9/13/95	10/12/95	No	No
WSI 01	CART	9/18/95	10/12/95	No	No
C1 (60-m tower) ECOR	CART	Pending	—	—	—
Aerosol facility	CART	10/23/95	1/19/95	No	Yes
Raman lidar	IDP/CART	9/15/95	1/19/95	No	No (preliminary documents received)
RCF	CART	3/96	—	—	—
SORTI 01	CART	1/96	—	—	—
Millimeter cloud radar	IDP/CART	2/96	—	—	—

[a] AERI, atmospherically emitted radiance interferometer; BBSS, balloon-borne sounding system; BLC, Belfort laser ceilometer; CART, Cloud and Radiation Testbed; EBBR, energy balance Bowen ratio; ECOR, eddy correlation; IDP, Instrument Development Program; IR, infrared; MFR, multifilter radiometer; MPL, micropulse lidar; MWR, microwave radiometer; ORR, Operational Readiness Review; PC, personal computer; RASS, radio acoustic sounding system; RCF, radiometer calibration facility; S, solar; SIROS, solar and infrared radiation observing system; SMOS, surface meteorological observation station; SORTI, solar radiance transmission interferometer; WSI, whole-sky imager.

wavelengths (450, 500, 700 nm); an integrating nephelometer with a 550-nm reference; a condensation particle counter (total > 0.1 μm); an ozone concentration sensor; and (perhaps) an optical absorption unit. The data are currently being collected remotely until ingestion software can be completed.

The soil water and temperature system (SWATS) is a joint venture between the GCIP and ARM. The GCIP has provided the SWATSs and data loggers, and ARM will install and operate the system. Phase I SWATS installation will begin during this six-month period. Phase I includes installation at the central facility, three Kansas extended facilities (Plevna, Elk Falls, and Ashton), and three Oklahoma extended facilities (Ringwood, Meeker, and Cordell) by April. Phase II SWATS installations will occur at three Kansas extended facilities (Larned, Hillsboro, and Coldwater) and five Oklahoma extended facilities (Tyro, Bryon, Pawhuska, Vici, and Cyril). Phase II installations will begin in the late spring of 1995. The remainder of the SGP CART site extended facilities will be outfitted with SWATSs in the spring of 1997.

An additional level of temperature and humidity observations is being added at the 25-m level of the 60-m tower at the central facility. The new sensors to be installed duplicate those at the 60-m level. This addition addresses the need for more complete measurements of temperature and humidity profiles at the central facility.

Installation of sensors to measure the downwelling hemispherical solar radiation in the ultraviolet B (UV-B) and photosynthetically active radiation bands at the central facility is planned for this six-month period. Requests for such observations have come from DOE offices, the ARM Program Office, and ecologists. Implementing these observations is an efficient means of increasing collaborations with other programs.

Plans are proceeding to place three or more infrared thermometers (IRTs) at the central facility, one pointing downward at the central facility, one pointing downward on the 10-m mast in the pasture, and one pointing downward at the 25-m level above the wheat field. The purpose of these IRTs is to establish (1) boundary conditions for calculations of cooling rate; (2) boundary conditions for calculations of spectral radiance and flux, for comparison with data from airborne radiometers; and (3) ground truth for satellite verification and calibration.

A second day-night WSI is scheduled for delivery to the SGP CART site this year for installation at an auxiliary site for studies of cloud structure and motion, providing a more complete three-dimensional view of clouds at the central facility.

During this six-month period, the radiometer calibration facility (RCF) is expected to be completed. This facility includes a calibration deck; a reference spectroradiometer (300-1,100 nm); a site reference cavity radiometer; a program reference cavity radiometer; a site working-standard cavity radiometer; automatic solar trackers for direct and diffuse solar measurements; reference diffuse pyranometers; working-standard pyranometers, pyrheliometers, and pyrgeometers; National Institute of Standards and Technology (NIST) standard lamps; blackbody circulators; and computer hardware and software support.

The current status of and plans for acquisition and deployment of all instruments are summarized in Tables A.1-A.3 in Appendix A.

Much of the SGP CART site installation is complete as originally planned. However, CART instrument performance, the availability of new commercial instruments, and additional data stream requirements result in a list of potential new instruments that is reviewed by ARM infrastructure staff. Recommendations are then made to the Science Team Executive Committee for approval. The instrument modifications and additions that have been suggested and are now under discussion within the ARM infrastructure staff include the following:

- Occasional tethersonde measurements of humidity profiles at the central facility

- Upgrades to the BBSS system (using GPS for tracking instead of Loran-C and using the new Vaisala RS-90 radiosondes, which are reported to have faster-response temperature and humidity sensors)

- Vaisala ceilometer for the central facility

- Zenith sky radiance in the near IR at the central facility (e.g., an uplooking near-IR shortwave radiance instrument with a field of view overlapping or nearly coincident with that of the MWR, with the cloud radar possibly specially designed and obtained from a commercial source)

- A commercially available optical transmissometer to detect particles like fog, dust, and drizzle at the central facility

- A Cimel sunphotometer for measurements of aerosol optical depth at the central facility and of sky irradiance along the solar almucantar and along the solar principal plane, including the solar aureole, for use in research on inferring aerosol size distribution and the scattering phase function

- Valero radiometers at the central facility and at extended or boundary facility locations to be identified

- Solar spectral observations at the central facility, requiring considerable directed development to modify comercially available portable field spectroradiometers (having a configuration unsuitable for a CART instrument) for a wavelength range of 350-1,100 nm

Measurements issues unresolved by the ARM infrastructure include the following:

- Installation of ceilometers at boundary facilities to decrease the uncertainties in estimates of temperature and humidity profiles based on data from AERIs

- Local observations of surface vegetative conditions at extended facilities (specifically, commercially available devices that measure the nondimensional vegetative index [NDVI]) for interpretation of NDVI values derived from remote sensing data from satellites

- Use of a commercial portable apparatus for rapid acquisition of bidirectional observations of the land and the atmosphere (PARABOLA) to provide surface bidirectional reflectance measurements at the central facility

- Addition of a passive MWR (Radiometrics) for obtaining profiles of temperature through clouds, to augument or supplant profile measurements made with the AERI at the central and/or boundary facilities

- Comparison of the cost of procuring a commercially available ozone profiling system versus the cost of contracting the service

- Evaluation of the feasibility and costs of improving the SIROS data logging at all extended facilities by converting to a Campbell data logger, because the MFRSR data logger now used for all SIROS instruments has inadequate data storage for more than two hours when electronic communications fail at extended facilities

3.4 Observations, Measurements, and External Data

The observations being delivered to the Experiment Center from the SGP CART site as of December 31, 1995, are summarized in Table B.1 in Appendix B. The availability of data from a particular platform on any given day is a function of quality control, with some segments temporarily unavailable during evaluation or correction of problems. Instruments operating at the site that are not in Table B.1 either are still under evaluation by the instrument mentors or are awaiting the creation of the data ingestion modules required to add their data to the SGP data stream.

The measurements being produced at the Experiment Center as of December 31, 1995, for distribution to the Science Team are listed in Table B.2 in Appendix B. This summary includes both the measurements derived from the SGP CART data and data streams from sources external to ARM (e.g., the gridded data from the National Meteorological Center's ETA Model). Table B.3 in Appendix B lists the external data that currently supplement the SGP CART data.

The Experiment Center will continue to prepare software to produce measurements from the available observations. Table B.4 in Appendix B lists the measurements, organized by type, derived from the SGP CART site and external data that are anticipated to exist by the end of this period (June 30, 1996).

3.5 Site Development Activities

3.5.1 Facilities

The infrastructure at the central facility is complete, including the power, telephones, and fiber-optic data network, along with three IDP pads that have continued to support visiting instruments. A fiber-optic upgrade was completed in December 1995, and upgrades to the site data system (SDS) will be completed in April 1996. In anticipation of the arrival of two daytime-nighttime WSIs, the first of six planned auxiliary facilities will need to be located.

Auxiliary facilities are to be 5-10 km distant from the central facility and at approximately the same elevation as the central facility. At least one auxiliary facility is expected to be located and leased during this period.

To accommodate the T-1 lines planned at the boundary facilities, a new trailer (10 × 30 ft) is being procured for installation in January 1996. The new trailer, a new SDS changeout, and increased work space to accommodate delivery of a future AERI and perhaps other equipment will finalize the boundary facilities. The final installation of the BBSS trailer on a concrete pad with a zero-plane grounding system reduced potential interference from the nearby NOAA profilers. This work was completed in December 1995.

On the basis of a recommendation from a subset of the Science Team, new locations for the three intermediate facilities with the new 915-MHz profilers and RASS units were identified during the last six-month period. The National Environmental Policy Act (NEPA) approval process has already begun and is expected to be completed by April 1996. Subsequently, support infrastructure (utilities, cement pads, housing structures for computers, etc.) can be implemented, and the instruments can be installed by the vendors. Instrument delivery schedules are uncertain.

As new IDP and CART instruments arrive at the central facility, special support structures are required. For example, the optical trailer was modified to accept the CART AERI 01 and AERI X, and the pad for the Raman lidar was constructed at IDP location 3 in October 1995. Installation of the millimeter cloud radar will be completed during this six-month period.

3.5.2 Development of the Site Data System

Several of the installed instruments and all of the new instruments will require creation of software to transfer the data from the instrument platforms to the SDS. Transfer of data by coded switches from the extended facilities has been established. Because the telephone lines cannot support data transfer from the boundary facilities, T-1 lines will be installed at these locations in time for the SCM IOP in April 1996.   Currently, the data from the boundary facilities (on cartridge tape) are delivered to the central facility daily by overnight express mail. This system causes a delay of three to five days in data ingestion in the SDS. Most of the ARM SGP instruments have their data collected (or delivered) to the SDS regularly, with data processed (i.e., ingested) and passed on to the Experiment Center and the ARM Archive. Some exceptions to this pattern will continue to occur during the next six months. These exceptions are as follows:

- SORTI. The SORTI data are retrieved directly by the instrument mentor and do not enter the SDS computers.

- WSI. The WSI is connected to the network. Currently, the data are written directly to tape, and the tapes are shipped to the instrument mentor.

- AERI 01. The AERI 01 data are retrieved by the Experiment Center, and ingestion of the data occurs there. The data do not enter the SDS computers.

- MPL. The MPL data are received by the SDS computers but are not processed (because no ingestion module has been developed), except that the raw data files are renamed to the ARM file-naming standard.

- Belfort laser ceilometer (BLC). The BLC data are collected by the SDS computers, but the processing (ingesting) of the data currently takes place at the Experiment Center.

- ECOR. The 3-m ECOR systems recently installed at the central facility and extended facilities currently write data files to an optical drive unit that stores data for 11.7 days. After this time, new data are written over the last existing data files, and so the last 3.5 days are lost until the communications module is completed. The optical data tapes are sent to the instrument mentor for data processing until the SDS communication file is complete. Data are retrieved only every two weeks from extended facilities.

- Raman lidar. Data are expected to be retrieved from the Raman lidar in an automated fashion by the instrument mentor, until ingest can be completed.

- SWATS. The SWATS data will be retrieved automatically by the instrument mentor until the ingest module is in place.

- The Aerosol Observation System (AOS). AOS data are being retrieved automatically every hour.

- Radiometer calibration facility (RCF). How data will be retrieved from the RCF is not clear at this time.

- Intermediate facility 915-MHz profilers and RASS. The spectral data from the 915-MHz profilers and RASS will be retrieved manually every two weeks. The consensus data will be retrieved automatically each day.

- Millimeter cloud radar. How data will be retrieved from the millimeter cloud radar is not clear at this time.

Further work is being undertaken to facilitate routine operations and particularly to assess instrument performance, including a broader suite of data display capabilities. Once the SDS is near completion, procedures for system management and maintenance need to be written and transferred to site operations staff. During this six-month period, site operations management will hire a site computer systems administrator, who will facilitate local SDS development, operation, and maintenance. In addition, during this six-month period, the SDS will address the ongoing need to make near-real-time data available for selected scientists during IOPs and campaigns and for educational outreach efforts in conjunction with the Oklahoma Climatological Survey's EARTHSTORM project.

3.6 Limiting Factors

The most basic of limiting factors is the amount of resources available to continue site development, expand operations, and provide necessary support for the IT and DSIT. Shortfalls result in delays in implementation. Shortfalls in vendor supplies, delays in obtaining information for PRRs, and budgeting problems have also been hindrances. Other significant limiting factors are the time lags inherent in the procurement process and the calibration of radiometers before installation.

All systems awaiting construction or installation go through a formal design review of structural and mechanical systems.   These reviews frequently identify deficiencies in plans and drawings related to engineering requirements, procurement details, safety, and quality control. This review activity was recently expanded to include large or complex IOPs (e.g., the ARESE IOP in September 1995) in an effort to integrate the exceptionally wide variety of IDP instrument support requirements for cost-effective and safe implementation. Neither construction nor installation can begin until the design review process has been successfully completed.

The costs associated with BBSS launches (primarily expendables) will continue to be a burden on the operations budget until these systems are replaced by continuous, unmanned remote sensing systems. These expenses are a strong constraint on the total number and frequency of launches, making impossible the routine provision of all of the requested launches (eight per day at the central and boundary facilities) defined as the optimal sounding strategy for SCM requirements by the DSIT (M. Bradley and R. Cederwall, unpublished information). A potential BBSS system upgrade to be tested during this six-month period uses directional antennas and new sondes. This upgrade should help reduce interference and produce higher-quality moisture profiles.

4 DATA QUALITY

Data quality issues are addressed at several levels within the ARM Program and at the SGP CART site. One of the goals of the ARM Program is to provide data streams of known, reasonable quality. Maintaining data quality for a program of this size and complexity is a significant challenge. Data quality assurance within the ARM Program infrastructure has matured over the past few years and will continue to evolve.

4.1 Instrument Mentors

Initially, instrument mentors are charged with developing the technical specifications for instruments procured for the ARM Program. The instrument mentor then tests and operates the instrument system (either at his/her location or at the SGP CART site). In addition, the mentor works with SDS personnel on ingestion software requirements. Data ingestion involves the conversion of data streams to the International System of Units (SI), as well as the acquisition of parameters that can be used to monitor instrument performance (e.g., monitoring an instrument's output voltage for a 5-V power supply or the continuity of the wire in a hot-wire anemometer). Data collection and ingestion, then, are the focus of the first level of data quality assurance. Quality at this level is monitored routinely by site operators and instrument mentors.

The next level of data quality assurance involves beta release of data streams from individual instruments. The mentor receives the data from the instrument to determine whether the technical specifications of the instrument are being met. When the mentor is satisfied that the instrument is functioning properly and that the technical specifications have been met, the data are formally released to the Science Team and other data users. The instrument mentor is also charged with reviewing the instrument data streams at least every two weeks, an action monitored at the Experiment Center.

4.2 Site Scientist Team

The SST helps to ensure that the scientific productivity of the SGP CART site is maximized by the routine and special (IOP) operations at the site. The SST acts a resource for the site operations manager and his staff on scientific matters related to instrument data streams by doing the following:

- Answering questions from site operations personnel concerning potential instrument problems

- Reviewing proposed instrument siting/deployment strategies, including the needs of the instrument mentor and instrument requirements for IOPs and campaigns

- Reviewing schedules and procedures for instrument calibration and maintenance (which will be reported in the *Calibration and Maintenance Plan* currently being drafted)

- Providing an initial confirmation of suspected instrument/data problems

These activities require constant communication with site operations staff, including routine visits to the central facility and occasional trips to extended and boundary facilities. These activities are highly coordinated with the site program manager. Ongoing focus activities of the SST will contribute to the goals of data quality assurance for the SGP CART site and ensure that the operation of the site meets, as nearly as possible, the overall scientific goals of the ARM Program.

In the past, data quality assurance efforts of the SST largely involved evaluation of individual and multiple sets of data streams as needed, on an exploratory or developmental basis; participation in QMEs; and participation in the creation of the Value-Added Products (VAPs) Working Group.

Now that operational activities have shifted from deployment to support of ongoing, continuous operation of a wide variety of instrumentation at many locations, a more comprehensive, systematic data quality assurance effort is being initiated by the SST. This effort is manifested not only by the *Calibration and Maintenance Plan* being drafted, but also by the development and use of automated, graphic data display techniques that plot multiple data streams for visual inspection. Such data quality display modules have already been developed for the broadband radiometer data.

Plans for this six-month period and beyond include development of display modules for nearly all data streams and development of explicit guidance materials to allow site operations staff to use the display modules effectively. Thus, with the assistance of the site operations staff, the SST will be able to serve the ARM Program goals better by laying a foundation for improving data credibility.

In addition, the SST, in conjunction with the site program manager, the site operations manager, the SDS, the DSIT, and Experiment Center personnel, plans to improve monitoring of parameters such as site installation status, instrument status, data ingestion status, and data quality status by issuing a monthly outlook table. Elements of this table will include month-end instrument status, data backup capacity, ingestion method, a forecast of installation data, whether on-line or ingested, and data quality status.

4.3 Quality Measurement Experiments

As part of the data quality assurance effort, our focus needs to go far beyond the calibration of instruments to intercomparisons of individual data streams and evaluations of our ability to capture an accurate representation of the state of the atmosphere. The QMEs are investigations designed to evaluate and enhance the ARM data quality. The QMEs are spearheaded by the instrument mentor, the DSIT, and the SST. These efforts are expected to lead to peer-reviewed publications, a result strongly encouraged by the ARM Program. Such publications would allow data quality to be documented in the open literature. Specific QMEs are listed in Section 5.4.

4.4 Data Quality Problems

Suspect data can be reported to the ARM Program by anyone via the Problem Identification Form (PIF) shown in Figure 3. The PIF is submitted electronically to the Problem Review Board (PRB), which is made up of representatives of all ARM Program functional groups and meets weekly. The PRB's function is to review PIFs and assign the problems to appropriate personnel for resolution. The PIF remains open until the problem has been officially addressed by a Corrective Action Report (CAR), shown in Figure 4. In addition, Data Quality Reports (DQRs), shown in Figure 5, are generated by an instrument mentor during his/her routine inspection of an instrument data stream. The PIFs, CARs, and DQRs are archived as a data quality information database.

Problem Identification Form

PIF No.

(PIF No. will be assigned by PIF Manager)

Subject:
Date submitted:

Submitted by:
Organization:
Telephone:
E-mail:

Problem description/change description: (Give a brief explanation with details. Attach samples and any supporting information. This should include a description of analysis leading to identification of problem and, if known, recommended action.)

Submitter's prioritization: (circle one)
- Critical-1
- Very Important-2
- Important-3
- Inconvenient-4
- Interesting-5

Where was this problem identified? (circle one)
- SGP Site Data System-SGPSDS
- Experiment Center-EC
- Archive-A
- TWP Site Data System-TWPSDS
- Field Instrument-FI
- During Data Analysis-DA
- Other (list location)

Does this problem affect data values or cause data loss? (circle one) Yes/No

Which platform(s)?

Specify (or estimate) begin and end dates for data loss:

Begin Date:	Time (UTC):
End Date:	Time (UTC):

Does this PIF result in a Software Change Request? (circle one) Yes/No

Where? (circle one) SGPSDS, TWPSDS, EC, A

Type (circle one) Developmental-1, Problem-2, Enhancement-3

Suggested distribution:

FIGURE 3 The Problem Identification Form

Corrective Action Report Form

CAR No.

(CAR No. will be assigned by PIF Manager)

Subject:

PIF number(s):

CAR submitted by:

Date CAR submitted:

How may we contact you?
E-mail:
Phone:

Classification of this CAR: (check one)

____ Information only, problem cannot be fixed
List reference PIF(s) in PIF closed section.
____ Software modification
Implemented by:
Date Time Local/UTC (circle one)
Tested by:
Date Time Local/UTC (circle one)
Installed by:
Date Time Local/UTC (circle one)
____ Other (list)

PIFs addressed: (List all PIFs closed or addressed by the CAR. In the solution comments section below, list the details of the corrective action that has taken place.)

PIF closed (circle one) Yes/No

Solution comments/technical actions taken:

FIGURE 4 The Corrective Action Report Form

The Data Quality Report Form

DRQ No.: Platform:

Subject:

Date submitted:
Submitted by:

____

Submitter's affiliation:
____ Instrument Mentor
____ Experiment Support Team Member
____ Science Team Member
____ Other _______________________

For questions or problems, please contact the ARM Experiment Center at 509-375-6898 or via e-mail at DQR@arm.gov.

Platform/measurement:
Level of data (raw, a0, a1, b1, c1, etc.):

Location of data collection:

Period of questionable data:
Begin Date: Time (UTC):
End Date: Time (UTC):

Data should be labeled:
____ Questionable
____ Incorrect
____ Wrong calibration
____ Other

Extent of problem:
____ All data fields affected
____ Only some data fields affected

Discussion of problem:

Other observations/measurements affected by this problem:

Suggested corrections for the problem (e.g., change calibration factor and recompute, flag data with this comment):

Data processing notes:

FIGURE 5 The Data Quality Report Form

5 SCIENTIFIC INVESTIGATIONS AND OPPORTUNITIES

In 1994, the ARM Program identified a need for the creation of the Site Advisory Committee (SAC) to provide assistance to the ARM Program Science Team, the SGP CART site scientist, and the SGP CART site program manager. The SAC's charter is to

- Evaluate the SGP CART site scientific mission,
- Provide scientific mission guidance for SGP CART site operations,
- Evaluate the research program of the site scientist,
- Evaluate the potential for collaboration with other research programs, and
- Provide recommendations for the SGP CART site educational outreach program.

The seven-member SAC is composed of ARM and non-ARM Program scientists who meet formally at least once per year. The first such meeting was held in November 1995 at the University of Oklahoma. A written report summarizing the SAC's recommendations based on this meeting is now being prepared for distribution to the ARM Management Team, the SST, the site operations manager, and the site program manager. Committee membership will be for three years.

5.1 Intensive Observation Periods

The base of the ARM Program at the SGP CART site is a suite of continuous observations, but a number of critical observations are either too expensive to be made continuously or require instrumentation that cannot be deployed continuously. In addition, some questions concerning data accuracy or representativeness (for either established instruments or prototypes) can be answered only with periods of more intense observations. Acquiring these observations will require special efforts and arrangements by the SGP site staff. Such efforts are categorized as IOPs, because they frequently include activities beyond the routine observations. The IOPs can be in support of the needs of the Science Team, QMEs, IDPs, campaigns, and even field tests of non-ARM instruments. Table 5 lists IOPs that have occurred, are in progress, or are in the design stage.

TABLE 5 Intensive Observation Periods

Date	Name	Science Team Member[a]	DSIT Contact[b]	Description	Status
11/92	Field Test of NCAR Flux Profiler	D. Parsons (NCAR)	R. Cederwall	Enhanced soundings at the central facility and profiler site were made 11/10-11/19; boundary layer flights were also conducted on a few days.	Completed; data available summer 1993
4/93	AERI Field Test	H. Revercomb (UW)	J. Liljegren	Enhanced soundings at the central facility were requested during the field acceptance test of the AERI instrument.	Completed 4/29/93
5/93-6/93	Using the GPS for the Measurement of Atmospheric Water Vapor	Collaborative (UNAVCO and NCSU)	J. Liljegren	The purpose was to test the investigators' technique for inferring total precipitable water vapor in the atmosphere column by using GPS signals.	Completed 6/8/93; data available
6/93	Warm-Season Data Assimilation and ISS Test	D. Parsons (NCAR)	R. Cederwall	This test was an enhanced sampling (in time and space) of the SGP domain for a 10-d period with profilers and sondes. The primary goals of the IOP were (1) to study the performance of FDDA under thermodynamic conditions typical of the continental warm season and (2) to evaluate the estimates of divergence and vorticity from the prototype NCAR ISS with interferometric techniques, the triangle of three 915-MHz profilers, and the results of FDDA.	Completed; all data available at the Experiment Center except for FDDA, which is available upon request at NCAR
1/94; 4/94; 7/94; 10/94; 4/95; 7/95; 9/95; 4/96; 7/96	Seasonal SCM IOP	D. Randall (CSU)	M. Leach	Seasonal IOP with enhanced frequency of observations, particularly vertical soundings of temperature, water vapor, and winds at central facility and boundary facilities for periods of 21 d; the required sounding frequency is 8/d. The data are required for quantifying boundary forcing and column response.	IOPs being planned for April and July 1996
4/94	ARM UAV	J. Vitko (SNL); G. Stokes (PNNL)	J. Liljegren	Measurements of clear-sky flux profiles acquired by a UAV and surface support data are to be used to understand clear-sky heating rates and the ability of models to reproduce the observations.	First IOP conducted successfully in April 1994; flight for ARESE IOP in September-October 1995

TABLE 5 (Cont.)

Date	Name	Science Team Member[a]	DSIT Contact[b]	Description	Status
4/94-5/94; 4/95-5/95	Remote Cloud Sensing Field Evaluation	R. McIntosh (UM); B. Kropfli (NOAA); T. Ackerman (PSU); K. Sassen (UU); A. Heymsfield (NCAR); J. Goldsmith (SNL); and others	M. Laufers-weiler; J. Griffin (IDP contact)	The primary purpose was the field evaluation and calibration of several remote sensing cloud-observing instruments (some from the IDP project). *In situ* cloud observations were critical to the success of this IOP. Enhanced soundings were required at the central facility.	Completed; data analysis in progress
5/94	WB-57 Overflight for the Measurement of Atmospheric Water Vapor at High Altitude	Collaborative (Visidyne and Lockheed PARC)	J. Liljegren	The purpose was to attempt to infer the vertical distribution of water vapor at high altitudes from solar transmission spectra.	Completed; preliminary transmission spectra delivered to ARM
5/94	VORTEX IOP	E. Rasmussen (NSSL)	D. Slater	Special launches were made in support of VORTEX, testing hypotheses on the development and dissipation of severe storms.	Completed May 31, 1994
8/94	GEWEX/GCIP/GIST IOP	Collaborative	T. Cress	Special launches were made in support of the GCIP and GIST as part of an effort to improve climate models by improving parameterizations of hydrologic and energy cycles.	Successfully conducted in August 1994
9/94-10/94; 6/95-7/95	Sampling of Coherent Structures with the 915-MHz Profiler	R. Coulter (ANL)	R. Cederwall	Fluctuations in the vertical wind and index of refraction were observed by operating the 915-MHz profiler with RASS in a special mode during the afternoon hours to sample convective plume structures.	Completed
4/95-5/95	Simultaneous Ground-Based, Airborne, and Satellite-Borne Microwave Radiometric and *In Situ* Observations of Cloud Optical Properties and Surface Emissivities	W. Wiscombe (NASA-GSFC); E. Westwater (NOAA-ETL)	D. Slater	Observations of cloud optical properties were obtained over the CART site simultaneously from ground-based, *in situ*, and satellite-borne sensors; spatial variability of surface emissivities was assessed to attempt retrieval of total precipitable water and cloud liquid water from the special sensor microwave imager.	Completed; involved collaboration between Wiscombe and L. Fedor at NOAA

TABLE 5 (Cont.)

Date	Name	Science Team Member[a]	DSIT Contact[b]	Description	Status
4/95-5/95	VORTEX-ARM	E. Westwater (NOAA-WPL); W. Wiscombe (NASA-GSFC); G. Stephens and P. Gabriel (CSU); J. Schneider (CIMMS/ NSSL)	D. Slater	A joint VORTEX-ARM proposal was approved for 45 h of P-3 aircraft time to study stratocumulus clouds. Work was coordinated with Remote Cloud Sensing IOP.	Data exchange completed December 1995
6/95-7/95	Surface Energy Exchange IOP	C. Doran (PNNL); R. Coulter (ANL); R. Stull (UW)	R. Cederwall	Detailed observations of the temperature and moisture profiles in the PBL obtained within a radius of 75-125 km of the central facility by using airsondes and profilers to evaluate the variations of the PBL structure in relation to underlying surface fluxes.	Completed; airsonde data available as beta release from C. Doran
9/95-10/95	ARESE	Collaborative	T. Cress	The purpose was to study the anomalous absorption of solar radiation by clouds. The phenomenon was first noticed when satellite measurements of solar radiation absorbed by the surface atmosphere were compared with solar radiation measured at collocated surface sites.	Completed; UAV data to be available in February 1996
2/96-6/96	Sensible Heat Flux IOP	Unspecified	R. Cederwall	This is a data evaluation IOP for sensible heat flux, comparing data from one or two scintillometers with data from EBBR and ECOR at the central facility.	Design in progress
4/96-5/96	SUCCESS	Collaborative	R. Peppler	The purpose is to determine the impact of the current and the future subsonic aircraft fleet on Earth's radiation budget and climate.	Design in progress
6/96	Atmospheric Emission Sounder Overflights	S. Clough (Atmospheric and Environmental Research, Inc.)	D. Slater	Special ozone sonde launches will support these flights.	Pending airborne platform

TABLE 5 (Cont.)

Date	Name	Science Team Member[a]	DSIT Contact[b]	Description	Status
6/96	MSX Satellite Overflights	Collaborative	H. Foote	The purpose is to provide ground truth support for the MSX satellite. Nine sensors operate in the range of 0.12-0.9 µm. A spectral IR imaging telescope also operates.	Pending launch of MSX satellite

[a] Affiliations: ANL, Argonne National Laboratory; CIMMS, Cooperative Institute for Mesoscale Meteorological Studies; CSU, Colorado State University; ETL, Environmental Technology Laboratory; GSFC, Goddard Space Flight Center; NASA, National Aeronautics and Space Administration; NCAR, National Center for Atmospheric Research; NCSU, North Carolina State University; NOAA, National Oceanic and Atmospheric Administration; NSSL, National Severe Storms Laboratory; PARC, Palo Alto Research Center; PNNL, Pacific Northwest National Laboratory; PSU, Pennsylvania State University; SNL, Sandia National Laboratories; UM, University of Massachusetts; UNAVCO, University NAVSTAR Consortium; UU, University of Utah; UW, University of Wisconsin; and WPL, Wave Propagation Laboratory.

[b] Other definitions: AERI, atmospherically emitted radiance interferometer; ARESE, ARM Enhanced Shortwave Experiment; CART, Cloud and Radiation Testbed; DSIT, Data and Science Integration Team; EBBR, energy balance Bowen ratio; ECOR, eddy correlation; FDDA, four-dimensional data assimilation; GCIP, GEWEX Continental-Scale International Project; GEWEX, Global Energy and Water Experiment; GIST, GCIP Integrated Systems Test; GPS, global positioning system; IDP, Instrument Development Program; IOP, Intensive Observation Period; IR, infrared; ISS, integrated sounding system; MSX, Midcourse Satellite Experiment; PBL, planetary boundary layer; RASS, radio acoustic sounding system; SCM, single-column model; SGP, Southern Great Plains; SUCCESS, Subsonic Aircraft: Contrail and Cloud Effects Special Study; UAV, unmanned aerospace vehicle; VORTEX, Verification of the Origins of Rotation in Tornadoes Experiment.

The SCM IOPs form the base for the IOP program. Scheduling other IOPs during SCM IOPs has a significant benefit in keeping costs manageable. The SGP site can support scientific investigations on relatively short notice (e.g., ARESE IOP), but budgetary impacts must be considered. The scientific prioritization of IOPs and their effects on routine operations are evaluated continuously.

The IOPs and campaigns are, in general, proposed to the DSIT by Science Team members, ARM infrastructure staff, the site scientist, or the SAC. The DSIT integrates and develops specific requirements into a document that is passed on to the site program manager for evaluation, assessment, and budgetary consideration.

Two IOPS of key scientific interest during this planning period are discussed below.

The Spring 1996 Single-Column Model (SCM) IOP. An SCM is essentially a physical parameterization package extracted from a general circulation model (GCM) or other large-scale model. The SCM is a primary test of our current understanding of clouds and radiative transfer. The SCM IOPs are designed to provide, as boundary conditions, the advective tendencies and vertical velocities that are the dynamic forcing normally calculated with a GCM. The BBSS is the only technology currently capable of providing the range and resolution of observations of winds and thermodynamic quantities necessary to estimate these boundary conditions. Because derivatives are needed in both horizontal directions, BBSS data from the central facility and the four boundary facilities are the minimum required for reliable estimates.

The Subsonic Aircraft: Contrail and Cloud Effects Special Study (SUCCESS) is a field program to investigate the effects of subsonic aircraft on contrails, cirrus clouds, and heterogeneous chemistry. The study is scheduled for April 10 to May 10, 1996, coincident with the April SCM IOP. The base of operations will be in Salina, Kansas. Aircraft flights will be concentrated in northern Oklahoma and in Kansas, with excursions to the Rocky Mountains near Boulder, Colorado, to study wave clouds. Although the SGP CART site will be favored as a location for SUCCESS measurements, some aircraft flights may occur in other regions if more favorable conditions exist there. Sassen's (K. Sassen, University of Utah) lidar and cloud radar will be located at the central facility. Associated with SUCCESS are the following NASA aircraft: ER-2 (at 65,000 ft), DC-8 (at 30,000-40,000 ft), T-39 (at 30,000-40,000 ft), and possibly the 757 (at 30,000-40,000 ft) and the NCAR Electra.

A Sensible Heat Flux IOP. The Sensible Heat Flux IOP will involve a data evaluation of sensible heat fluxes from the energy balance Bowen ratio (EBBR) and ECOR platforms, as well as one or more scintillometers (to be provided by Argonne National Laboratory or Pacific Northwest National Laboratory). The ARM Program currently estimates sensible heat flux from the EBBR and measures it directly with the ECOR, although the ECOR is located at the boundary of the ground cover of interest (i.e., wheat). The scintillometer allows the direct measurement of turbulent heat flux above a given ground cover over a horizontal path length of about 100 m. This IOP will help to improve the level of confidence in the ARM EBBR and ECOR sensible heat flux data. This IOP will ideally start in February 1996, when winter wheat begins growing, and would continue through June 1996 when the wheat matures. This IOP is currently under design.

5.2 Potential Collaborative Investigations

Argonne National Laboratory is developing a new research facility within the existing boundaries of the SGP CART site, to be devoted to studies of the planetary boundary layer. The Argonne Planetary Boundary Layer Facility (PBLF) will cover an area approximately 50 km × 50 km within the Walnut River watershed in Butler County, Kansas, about 30 miles east of Wichita and near the Towanda extended facility. New techniques of observation and data fusion will be developed and used to study the nocturnal low-level wind maximum and its relation to the synoptic jet features; to develop methods for spatial integration of air-surface exchange of heat, gases, and momentum; and to study horizontal and vertical dispersion in the planetary boundary layer. The intial set of instrumentaion available at the PBLF will include two 915-MHz profilers with RASS, three minisodars, one lidar ceilometer, one BBSS, five surface ECOR flux stations, five soil moisture and temperature stations, and one satellite data receiver processor. One central location will house data collection equipment and instrumentation and will provide accomodations for visiting scientists. The data obtained will be provided in real time to a user community of atmopsheric scientists and ecologists.

The Cooperative Atmosphere-Surface Exchange Study (CASES) is a collaborative effort to obtain measurements over the entire Walnut River watershed (approximately 100 km × 100 km) in and around Butler County, Kansas, about 30 miles east of Wichita. The CASES initiative will obtain measurements over a somewhat larger domain than the PBLF. CASES will include hydrologic, ecologic, and atmospheric chemistry studies, in addition to planetary boundary layer research.

5.3 Design of Intensive Observation Periods

The initial design of most of the special operations is in the hands of the DSIT. Prototype procedures to facilitate the design, review, and implementation processes are specified for the planning of IOPs. Examples of such plans were included in Appendices A and B of Schneider et al. (1993). Similar documents are being prepared by the Campaign Team leader to facilitate interagency collaborations and by the Operations Team leader to facilitate the use of guest instruments. The SST will assist the DSIT in the generation of plans for special operations; will include the plans for newly approved QMEs, IOPs, and campaigns in the *Site Scientific Mission Plan;* and will assist in the execution of special operations. With the many-month lead time necessary to schedule research aircraft, the design of special operations involving aircraft should begin more than a year before the projected operation and should be sufficiently complete to be included in collaborative proposals.

5.4 Quality Measurement Experiments

As discussed in Section 4.3, QMEs are investigations designed to enhance the ARM data quality by providing information derived from a continuous intercomparison of alternative measurements or models of observed geophysical quantities. During this six-month period, a high priority will again be given to comparisons of similar data streams from different instrument packages, a natural and obvious complement to the efforts of the instrument mentors. A number of QMEs developed by instrument mentors, the SST, or the DSIT will be conducted by employing routine observations.

Examples of QMEs include the ongoing comparisons of (1) the AERI spectral radiances with the values calculated via the line-by-line radiative transfer model (LBLRTM) and (2) the integrated columnar water vapor measured by the microwave radiometer (MWR) with that calculated from the vertical integration of water vapor estimates from the BBSS and Raman lidar. Prospective QMEs include comparison of (1) water vapor profiles retrieved from the MWR with the BBSS and Raman lidar moisture profiles; (2) the brightness temperatures observed by the MWR with values calculated by using the LBLRTM at the specific wave numbers at which the MWR operates; (3) cloud base heights derived from the BLC, MPL, and Raman lidar with cloud base heights derived from other cloud radars as available; (4) the observed to calculated broadband radiative surface fluxes; (5) virtual temperature and velocity profiles from the BBSS with data from the 915- and 50-MHz profilers and Raman lidar; (6) temperature, humidity, and pressure measurements from the surface meteorological observation stations (SMOSs) with those from the 25-m and 60-m levels on the 60-m tower and the EBBR system; and (7) momentum, heat, and moisture fluxes derived from the EBBR with those from ECOR systems. Many such studies under consideration would help to evaluate the vendor-specified operating ranges, as well as the precision and accuracy of the CART instruments.

5.5 Value-Added Products

The VAPs Working Group provides a mechanism for generating scientifically useful data (including products from QMEs) for geophysical quantities that are important to the ARM Program, including the SGP site. Value-added products are second-generation data streams derived by applying algorithms to existing data streams. The VAPs Working Group is composed of scientists from the DSIT, IT, and SST. The group is dedicated to data quality issues. Its tasks are to prioritize the creation of products focused on key geophysical quantities and to facilitate the implementation of procedures to generate such products. The results of these efforts, including the results of QMEs, will have both short- and long-term effects on the ARM data stream and on site management, including advisories to the Science Team concerning data quality, modifications in strategies for data acquisition, and reassessments of measurement algorithms. The most important and unique of the instrument comparisons will be distributed as internal ARM reports and submitted for publication in appropriate peer-reviewed journals.

5.6 Geophysically Significant Phenomena

The ARM Program is in transition toward a new paradigm that will sharpen the focus of the DSIT and other groups (such as the VAPs Working Group) on the study of geophysically significant phenomena (e.g., water vapor profiles, aerosols, clouds, temperature profiles, radiation). The intent is to push toward algorithm development that captures these phenomena as products rather than focusing on individual data streams.

The algorithm-type products would represent a merging of appropriate instrument measurements into a cohesive product defining a particular geophysical state, for use by the Science Team. These products would specifically address problems posed in the draft ARM science plan and by various working groups. An algorithm product currently under discussion is a water vapor profile product being sought by the IRF Working Group. Such an effort might involve an IOP addressing algorithm development by obtaining additional temperature and relative humidity measurements at the central facility (e.g., additional measurements at the 25-m level on the 60-m tower and with a tethered sonde system) and comparison of these measurements with BBSS, Raman lidar, and 915- and 50-MHz RASS water vapor profiles. The end result of such a comparison would be the generation of an ensemble, site-representative water vapor profile for use in GCMs.

5.7 Campaign Planning

Table 6 summarizes potential campaigns and cooperative projects that have been called to the attention of CART site management. Plans for these activities are in various stages of development, and the topics are listed briefly in the table to generate further discussion. Inclusion in this list does not imply any endorsement of these activities by the ARM Program.

5.8 Educational Outreach

The educational outreach program for the SGP CART site, coordinated by Dr. Ken Crawford, Director of the Oklahoma Climatological Survey (OCS), combines a range of resources available at the University of Oklahoma. Outreach efforts are focused at the precollege, undergraduate, and graduate levels. Efforts in this six-month period are focused on integration of ARM and NWS data (as nearly in real time as possible) into the EARTHSTORM project, a program conducted by the OCS to integrate real-time data into classroom activities in kindergarten through grade 12 (McPherson and Crawford 1996). The EARTHSTORM project currently accesses data from the Oklahoma Mesonet, a high-density network of surface meteorological stations, and provides the data to students in real time. EARTHSTORM has created learning modules and has provided teacher workshops to enhance the use of Oklahoma Mesonet data. Extension of these activities to ARM data can occur after a routine data transfer protocol is established. Extension of these efforts to the Tropical Western Pacific and North Slope of Alaska ARM sites will be investigated.

TABLE 6 Collaborative Campaigns and Cooperative Activities in Progress or under Discussion

Title[a]	Proponent/Contact[b]	Projected Date
GEWEX		
GCIP	J. Leese	1995-1996
ISLSCP	P. Sellers	1995-1996
GVaP	H. Melfi	Spring 1996
GCSS	M. Moncrieff	To be determined
Soil Moisture and Temperature Profiling	J. Schneider (NSSL)	1995-1997
WB-57 Overflight IOP	J. Liljegren	As requested
Argonne PBLF	R. Coulter	1996
MSX Satellite Overflights IOP	T. Cress	To be determined
SUCCESS IOP	T. Cress/D. McDoughal	1996
GBRS IOP	J. Griffin	1996
ARM UAV IOP	J. Vitko	1996
University of Wyoming King Air Flights	R. Stull (UW)	1996
EVAC IOP	M. Morrissey (OU)	1996

[a] EVAC, Environmental Verification and Analysis Center; GBRS, Ground-Based Remote Sensing; GCIP, GEWEX Continental-Scale International Project; GCSS, GEWEX Cloud Study System; GEWEX, Global Energy and Water Cycle Experiment; GVaP, GEWEX Water Vapor Project; IOP, Intensive Observation Period; ISLSCP, International Satellite Land-Surface Climatology Project; MSX, Midcourse Satellite Experiment; PBLF, Planetary Boundary Layer Facility; SUCCESS, Subsonic Aircraft: Contrail and Cloud Effects Special Study; UAV, unmanned aerospace vehicle.

[b] Affiliations: NSSL, National Severe Storms Laboratory; OU, University of Oklahoma; UW, University of Wisconsin.

6 DISTRIBUTION OF DATA

Most of the data being requested are received from the SGP CART site or external data sources and are then repackaged for weekly distribution to individual users. In some cases, users can log into the Experiment Center and extract data by anonymous file transfer protocol (FTP). The Experiment Center has developed a method to track the progress of data streams. This method is summarized on the World Wide Web (http://www.arm.gov/stdocs/dst) in a table that has been partially reproduced in Table 7. The information provided includes the name of the instrument base or the source of the external data set, the name of the data stream, the DSIT member to contact to obtain the data stream, the status of data availability, whether the individual data stream is ingested, the number of people who have requested the data, and the person responsible for releasing the data and periodically checking the data stream quality. A yes (Y) in the "Ingested" column means that data streams are available, that an ingestion program has been written for the data stream, and that the data are of sufficient quality to be releasable.

The status of data streams from CART instruments or external sources has been classified as releasable (released upon request for the data stream), developmental (released only to SDS personnel for development of ingestion programs), under evaluation (released to an investigator for an initial data quality check), beta release (for releasable data of known and reasonable quality), collecting (when raw data are being collected for future processing and distribution), mentor only (when the data stream is provided only to the instrument mentor at the request of the mentor), analysis (if the data stream is released for further processing and/or analysis, such as for graphic display), or defunct (due to replacement of a prototype instrument data stream with the CART instrument data stream). Table 7 shows that at the beginning of this six-month period, 100 data streams are releasable, with only 4 not ingested. However, 49 data streams are still not releasable.

The Web site discussed above includes further information about the dates and status of ingestion software development, when data streams were first released, and when data streams were last reviewed by the person responsible for the data stream quality.

TABLE 7 Data Stream Availability as of December 31, 1995

Base[a]	Data Stream	Access Contact	Avail-ability[b]	Ingested[c]	Requests	Quality Contact
Currently Operating Platforms						
ABRFC	sgpabrfcpcpX1.c1	Tichler	R	Y	4	Cederwall
ACAR	sgpacarsX1.a1	Tichler	D	N	0	Leach
AERI	sgpaeri01ch1C1.a1	Flynn	R	Y	14	Flynn
AERI	sgpaeri01ch2C1.a1	Flynn	R	Y	14	Flynn
AERI	sgpaeri01engineerC1.a1	Flynn	R	Y	5	Flynn
AERI	sgpaeri01summaryC1.a1	Flynn	R	Y	16	Flynn
AERI	sgpaeriprofC1.c2	Turner	D	N	0	—[d]
AERI/LBL	sgpaerilblcloudsC1.c1	Turner	E	Y	6	Turner
AERI/LBL	sgpaerilbldiffC1.c1	Turner	E	Y	14	Turner
AERI/LBL	sgpqmeaerilblC1.c1	Turner	E	Y	13	Turner
AERI/LBL	sgpqmeaerimeansC1.c1	Turner	E	Y	17	Turner
AVHRR	sgpavhrr12radX1.c1	Minnett	R	Y	1	Minnett
AVHRR	sgpavhrr12X1.c1	Minnett	R	Y	2	Minnett
AVHRR	sgpavhrr14radX1.c1	Minnett	R	Y	1	Minnett
AVHRR	sgpavhrr14X1.c1	Minnett	R	Y	2	Minnett
AVHRR	sgpavhrr9radX1.a1	Minnett	NO	Y	1	Minnett
AVHRR	sgpavhrr9X1.a1	Minnett	NO	Y	0	Minnett
BLC	sgpblcC1.a1	Flynn	R	Y	57	Flynn
BSRN	sgpbsrnC1.a1	Wesely	R	Y	57	Wesely
EBBR	sgp30ebbrE12.a1	Cook	B	Y	29	Cook
EBBR	sgp30ebbrE13.a1	Cook	B	Y	35	Cook
EBBR	sgp30ebbrE15.a1	Cook	R	Y	29	Cook
EBBR	sgp30ebbrE20.a1	Cook	R	Y	29	Cook
EBBR	sgp30ebbrE22.a1	Cook	B	Y	29	Cook
EBBR	sgp30ebbrE26.a1	Cook	B	Y	29	Cook
EBBR	sgp30ebbrE4.a1	Cook	B	Y	29	Cook
EBBR	sgp30ebbrE7.a1	Cook	R	Y	29	Cook
EBBR	sgp30ebbrE8.a1	Cook	B	Y	30	Cook
EBBR	sgp30ebbrE9.a1	Cook	R	Y	29	Cook
EBBR	sgp5ebbrE*.a1	Cook	—	—	—	—
EBBR	sgp15ebbrE*.a0	Cook	—	—	—	—
ECOR	sgp30ecorE*.a1	Hart	D	N	—	—
ETA	sgpalleta90X1.00	Laufersweiler	C	—	0	Laufersweiler
ETA	sgpalleta90X1.c1	Laufersweiler	D	N	3	Laufersweiler
ETA	sgpeta90X1.c1	Laufersweiler	D	N	5	Laufersweiler
ETA	sgpetaderivX1.c1	Laufersweiler	D	N	4	Laufersweiler
GOES	sgpgoes8visX1.a1	Minnett	R	Y	2	Minnett
GOES	sgpgoes8X1.a1	Minnett	R	Y	4	Minnett

TABLE 7 (Cont.)

Base[a]	Data Stream	Access Contact	Availability[b]	Ingested[c]	Requests	Quality Contact
Currently Operating Platforms (Cont.)						
KSU	sgp1440ksumesoX1.a1	Tichler	R	N	23	Cederwall
KSU	sgp60ksumesoX1.a1	Tichler	R	N	25	Cederwall
LBL	sgplblch1C1.c0	Shippert	R	Y	12	Shippert
LBL	sgplblch1C1.c1	Shippert	R	Y	12	Shippert
LBL	sgplblch2C1.c0	Shippert	R	Y	12	Shippert
LBL	sgplblch2C1.c1	Shippert	R	Y	12	Shippert
MFR	sgpmfr10mC1.a1	Barnard	NO	N	13	Barnard
MFR	sgpmfr25mC1.a1	Barnard	B	Y	17	Barnard
MFRSR	sgpmfrsrN1.a0	Barnard	M	Y	14	Barnard
MPL	sgpmplC1.00	Flynn	M		3	Flynn
MPL	sgpmplC1.a0	Flynn	D	N	3	Flynn
MPL	sgpmplcbhC1.c1	Scott	R	Y	26	Scott
MWR	sgp1mwravgC1.c1	Liljegren	R	Y	2	Liljegren
MWR	sgp5mwravgB1.c1	Liljegren	R	Y	25	Liljegren
MWR	sgp5mwravgB5.c1	Liljegren	R	Y	25	Liljegren
MWR	sgp5mwravgB6.c1	Liljegren	R	Y	16	Liljegren
MWR	sgp5mwravgC1.c1	Liljegren	R	Y	64	Liljegren
MWR	sgpmwrcalC1.c1	Shippert	A	N	0	—
MWR	sgpmwrlosB1.a0	Liljegren	M	Y	2	Liljegren
MWR	sgpmwrlosB1.a1	Liljegren	R	Y	17	Liljegren
MWR	sgpmwrlosB4.a0	Liljegren	M	Y	2	Liljegren
MWR	sgpmwrlosB4.a1	Liljegren	R	Y	18	Liljegren
MWR	sgpmwrlosB5.a0	Liljegren	M	Y	2	Liljegren
MWR	sgpmwrlosB5.a1	Liljegren	R	Y	17	Liljegren
MWR	sgpmwrlosB6.a0	Liljegren	M	Y	2	Liljegren
MWR	sgpmwrlosB6.a1	Liljegren	R	Y	12	Liljegren
MWR	sgpmwrlosC1.a0	Liljegren	M	Y	2	Liljegren
MWR	sgpmwrlosC1.a1	Liljegren	M	Y	43	Liljegren
MWR	sgpmwrprofC1.c2	Turner	D	N	20	—
MWR	sgpmwrtipB1.a0	Liljegren	M	Y	5	Liljegren
MWR	sgpmwrtipB4.a0	Liljegren	M	Y	5	Liljegren
MWR	sgpmwrtipB5.a0	Liljegren	M	Y	5	Liljegren
MWR	sgpmwrtipB6.a0	Liljegren	M	Y	2	Liljegren
MWR	sgpmwrtipC1.a0	Liljegren	M	Y	1	Liljegren
MWR	sgpqmemwrprofC1.c1	Turner	D	N	0	—
MWR/LBL	sgpmwrlblC1.c1	Shippert	D	N	0	—
MWR/LBL	sgpqmemwrlblC1.c1	Shippert	D	N	0	—

TABLE 7 (Cont.)

Base[a]	Data Stream	Access Contact	Availability[b]	Ingested[c]	Requests	Quality Contact
Currently Operating Platforms (Cont.)						
MWR/Sonde	sgpqmemwrcolB1.c1	Turner	R	Y	7	Turner
MWR/Sonde	sgpqmemwrcolB4.c1	Turner	R	Y	7	Turner
MWR/Sonde	sgpqmemwrcolB5.c1	Turner	R	Y	7	Turner
MWR/Sonde	sgpqmemwrcolB6.c1	Turner	R	Y	6	Turner
MWR/Sonde	sgpqmemwrcolC1.c1	Turner	R	Y	21	Turner
NWS	sgpnwssurfX1.00	Tichler	R	—	2	Cederwall
NWS	sgp60nwssurfX1.a1	Tichler	D	N	—	—
NWS	sgp720nwssurfX1.a1	Tichler	D	N	—	—
NWS	sgpnwsupaX1.00	Tichler	R	—	4	Cederwall
OKM	sgp05okmX1.a1	Tichler	R	Y	28	Cederwall
OKM	sgp15okmX1.a1	Tichler	R	Y	11	Cederwall
Site Operations	siteopsC1.a1	Shippert	A	N	0	—
Reference	refMLSspecmapX1.c1	Turner	R	N	11	Turner
RUCS	sgprucs60X1.c1	Laufers	A	N	0	Laufersweiler
RWP	sgp50rwptempC1.a1	Coulter	R	Y	7	Coulter
RWP	sgp50rwptempC1.a2	Coulter	R	Y	19	Coulter
RWP	sgp50rwpwindC1.a1	Coulter	R	Y	6	Coulter
RWP	sgp50rwpwindC1.a2	Coulter	R	Y	16	Coulter
RWP	sgp915rwptempC1.a1	Coulter	R	Y	9	Coulter
RWP	sgp915rwptempC1.a2	Coulter	R	Y	23	Coulter
RWP	sgp915rwpwindC1.a1	Coulter	R	Y	6	Coulter
RWP	sgp915rwpwindC1.a2	Coulter	R	Y	21	Coulter
RWP	sgprwptempC1.c1	Turner	R	Y	1	Turner
SIROS	sgpsirosE10.a1	Barnard	NR	N	5	Barnard
SIROS	sgpsirosE11.a1	Barnard	B	Y	14	Barnard
SIROS	sgpsirosE12.a1	Barnard	NR	N	12	Barnard
SIROS	sgpsirosE13.a1	Barnard	B	Y	60	Barnard
SIROS	sgpsirosE15.a1	Barnard	B	Y	30	Barnard
SIROS	sgpsirosE16.a1	Barnard	B	Y	14	Barnard
SIROS	sgpsirosE20.a1	Barnard	NR	N	13	Barnard
SIROS	sgpsirosE22.a1	Barnard	R	Y	13	Barnard
SIROS	sgpsirosE24.a1	Barnard	NR	Y	0	Barnard
SIROS	sgpsirosE4.a1	Barnard	NR	N	11	Barnard
SIROS	sgpsirosE7.a1	Barnard	NR	N	11	Barnard
SIROS	sgpsirosE8.a1	Barnard	B	Y	12	Barnard
SIROS	sgpsirosE9.a1	Barnard	NR	N	28	Barnard
SIROS	sgpsirosopdepthE13.c1	Barnard	E	N	19	Barnard
SIROS	sgpsirosopdepthE15.c1	Barnard	E	N	5	Barnard
SIROS	sgpsirosopdepthE9.c1	Barnard	E	N	4	Barnard

TABLE 7 (Cont.)

Base[a]	Data Stream	Access Contact	Avail-ability[b]	Ingested[c]	Requests	Quality Contact
Currently Operating Platforms (Cont.)						
SMOS	sgp1smosE1.a0	Hart	E	Y	2	Hart
SMOS	sgp1smosE11.a0	Hart	R	Y	2	Hart
SMOS	sgp1smosE13.a0	Hart	R	Y	11	Hart
SMOS	sgp1smosE15.a0	Hart	R	Y	3	Hart
SMOS	sgp1smosE20.a0	Hart	R	Y	4	Hart
SMOS	sgp1smosE24.a0	Hart	R	Y	2	Hart
SMOS	sgp1smosE4.a0	Hart	R	Y	2	Hart
SMOS	sgp1smosE7.a0	Hart	R	Y	2	Hart
SMOS	sgp1smosE8.a0	Hart	R	Y	4	Hart
SMOS	sgp1smosE9.a0	Hart	R	Y	4	Hart
SMOS	sgp30smosE1.a1	Hart	R	Y	13	Hart
SMOS	sgp30smosE11.a1	Hart	R	Y	15	Hart
SMOS	sgp30smosE13.a1	Hart	R	Y	53	Hart
SMOS	sgp30smosE15.a1	Hart	R	Y	30	Hart
SMOS	sgp30smosE20.a1	Hart	R	Y	28	Hart
SMOS	sgp30smosE24.a1	Hart	R	Y	13	Hart
SMOS	sgp30smosE4.a1	Hart	R	Y	17	Hart
SMOS	sgp30smosE7.a1	Hart	R	Y	18	Hart
SMOS	sgp30smosE8.a1	Hart	R	Y	29	Hart
SMOS	sgp30smosE9.a1	Hart	R	Y	28	Hart
Sonde	sgpobjsondprof.c1	Yio	R	N	2	Leach
Sonde	sgpsondewndcalcB1.c1	Leach	R	Y	3	Leach
Sonde	sgpsondewndcalcB4.c1	Leach	R	Y	3	Leach
Sonde	sgpsondewndcalcB5.c1	Leach	R	Y	3	Leach
Sonde	sgpsondewndcalcB6.c1	Leach	R	Y	3	Leach
Sonde	sgpsondewndcalcC1.c1	Leach	R	Y	3	Leach
Sonde	sgpsondewrpnB1.a1	Lesht	R	Y	35	Lesht
Sonde	sgpsondewrpnB4.a1	Lesht	R	Y	34	Lesht
Sonde	sgpsondewrpnB5.a1	Lesht	R	Y	34	Lesht
Sonde	sgpsondewrpnB6.a1	Lesht	R	Y	25	Lesht
Sonde	sgpsondewrpnC1.a1	Lesht	R	Y	70	Lesht
60-m Tower	sgp1twr21xC1.a0	Cook	R	Y	9	Cook
60-m Tower	sgp30twr21xC1.a1	Cook	R	Y	27	Cook
WPDN	sgp06wpdnmmtsX1.a1	Tichler	R	Y	6	Leach
WPDN	sgp06wpdnrassX1.a1	Tichler	D	N	—	Leach
WPDN	sgp60wpdnmmtsX1.a1	Tichler	S	N	1	Leach
WPDN	sgp60wpdnrassX1.a1	Tichler	D	N	—	Leach
WPDN	sgp60wpdnsurfX1.b1	Tichler	R	Y	6	Leach
WPDN	sgp60wpdnwndsX1.b1	Tichler	R	Y	8	Leach
WSI	sgpwsicloud01C1.00	Thorne	D	N	0	Thorne

TABLE 7 (Cont.)

Base[a]	Data Stream	Access Contact	Availability[b]	Ingested[c]	Requests	Quality Contact
Defunct Platforms						
AERI	sgpaerich1C1.a1	Turner	DR	N	NA[e]	Turner
AERI	sgpaerich2C1.a1	Turner	DR	N	NA	Turner
AERI	sgpaerisummaryC1.a1	Turner	DR	N	NA	Turner
AERI	sgpaerich1C1.a2	Turner	DR	N	NA	Turner
AERI	sgpaerich2C1.a2	Turner	DR	N	NA	Turner
AERI	sgpaerisummmaryC1.a2	Turner	DR	N	NA	Turner
AERI	sgpaeridqflagC1.a1	Turner	DND	N	NA	Turner
AVHRR	sgpavhrrX1.b1	Liljegren	DU	N	NA	Liljegren
BSRN	sgpbsrncalcC1.c1	Shippert	DU	N	NA	Shippert
Cess Algorithm	sgp1toacessC1.c1	Shippert	DU	N	NA	Shippert
GOES	sgpgoesirX1.b1	Liljegren	DR	N	NA	Liljegren
GOES	sgpgoesvisX1.b1	Liljegren	DR	N	NA	Liljegren
GOES	sgpgoes7ir8X1.a1	Minnett	DR	N	NA	Minnett
GOES	sgpgoes7irX1.a1	Minnett	DR	N	NA	Minnett
GOES	sgpgoes7rad8X1.a1	Minnett	DR	N	NA	Minnett
GOES	sgpgoes7radX1.a1	Minnett	DR	N	NA	Minnett
GOES	sgpgoes7visX1.a1	Minnett	DR	N	NA	Minnett
KSU	sgpksudlymesoX1.b1	Tichler	DNR	N	NA	Tichler
KSU	sgpksuhrlymesoX1.b1	Tichler	DNR	N	NA	Tichler
MAPS	sgpmaps60derivX1.c1	Laufersweiler	DU	N	NA	Cederwall
MAPS	sgpmaps60X1.c1	Laufersweiler	DU	N	NA	Cederwall
MAPS	sgpmapsall60X1.c1	Laufersweiler	DU	N	NA	Cederwall
MWR	sgpmwrtipC1.a1	Liljegren	DU	N	NA	Liljegren
NGM	sgpngm250derivX1.c1	Cederwall	DU	N	NA	Cederwall
NGM	sgpngm250X1.c1	Cederwall	DU	N	NA	Cederwall
Sonde	sgpsondeB1.a1	Lesht	DR	N	NA	Lesht
Sonde	sgpsondeB4.a1	Lesht	DR	N	NA	Lesht
Sonde	sgpsondeB5.a1	Lesht	DR	N	NA	Lesht
Sonde	sgpsondeB6.a1	Lesht	DR	N	NA	Lesht
Sonde	sgpsondeC1.a1	Lesht	DR	N	NA	Lesht
Sonde	sgpsondenogcwrpnC1.c1	Shippert	DU	N	NA	Shippert

TABLE 7 (Cont.)

Base[a]	Data Stream	Access Contact	Availability[b]	Ingested[c]	Requests	Quality Contact
Defunct Platforms (Cont.)						
WSI	sgpwsicloudC1.b1	Thorne	DR	N	NA	Thorne
WSI	sgpwsicloudC1.c1	Thorne	DR	N	NA	Thorne

[a] Bases: ABRFC, Arkansas Basin Red River Forecast Center; ACAR, Aerodynamic Communication and Recording System; AERI, atmospherically emitted radiance interferometer; AVHRR, advanced very-high-resolution radiometer; BLC, Belfort laser ceilometer; BSRN, Broadband Solar Radiation Network; Cess, R. Cess, State University of New York; EBBR, energy balance Bowen ratio; ECOR, eddy correlation; ETA, National Meteorological Center model; GOES, geostationary orbiting Earth satellite; KSU, Kansas State University; LBL, line by line; MAPS, Mesoscale Analysis and Prediction System; MFR, multifilter radiometer; MFRSR, multifilter rotating shadowband radiometer; MPL, micropulse lidar; MWR, microwave radiometer; NGM, nested grid model; NWS, National Weather Service; OKM, Oklahoma Mesonet; RUCS, rapid update cycle; RWP, radar wind profiler; SIROS, solar and infrared radiation observing system; SMOS, surface meteorological observation station; WPDN, Wind Profiler Demonstration Network; WSI, whole-sky imager.

[b] Availability: A, analysis; B, beta release; C, collecting; D, developmental; DND, defunct no data; DR, defunct releaseable; DU, defunct unknown; E, evaluation; M, mentor only; NO, not operational; NR, not releasable; R, releasable; S, suspended.

[c] Y, yes; N, no.

[d] Information unavailable.

[e] NA, data stream not available.

7 LOOKING AHEAD

As indicated in earlier sections, although budgetary limitations, delays in procurement, and the operation of IOPs (especially ARESE) have somewhat slowed the development of the SGP CART site, the strong recent effort has led to much progress. Thus, by the end of this six-month period, the site (as originally envisaged) will be essentially complete. Any further site development (see below) will constitute an enhancement of the original design. By June 1996, the site will therefore be providing the full range of data streams needed to support the DSIT's algorithm development effort, which is now beginning to focus on geophysically significant phenomena (water vapor profiles, clouds, aerosols, temperature profiles, radiation).

Several recent or anticipated developments at the central facility are worthy of particular note. First, the expected enhancement by July 1996 of some of the basic observing capabilities at the central facility (e.g., deployment of day-night WSI, improved AERI, and IDP millimeter cloud radar, as well as routine operation of the permanent Raman lidar) will support a more complete specification of the radiative state of the lower atmosphere. This specification will be valuable to many IRF Science Team members, particularly if it is complemented by the development of procedures to independently make accurate measurements of the temperature and water vapor distributions in the lowest 200 m of the atmosphere. The development of the latter capability, which will be increasingly pursued (see below), was strongly urged by participants in the September 1994 and January 1996 IRF Workshops at the University of Maryland. The IDP millimeter cloud radar will be equipped to map the vertical extent of cloud boundaries up to a height of approximately 20 km. Measurements of vertical wind speed will be made by Doppler analysis. The system will operate only in the vertically pointing position. The addition of the cloud radar will enhance the ongoing efforts of the VAPs Working Group to improve the definition of cloud characteristics (fractional coverage, as well as base and top heights) above the central facility in coordination with key Science Team members.

The anticipated routine operation of the permanent Raman lidar, following the initial deployment by the instrument mentor, is eagerly anticipated, particularly by IRF Science Team members. Such optimism reflects the potential of this state-of-the-science instrument to characterize the atmosphere (e.g., water vapor, clouds, aerosols) more accurately and with finer vertical resolution than is possible with the existing suite of instruments (radiosondes and microwave radiometers). The September 1994 IRF Workshop accordingly recommended that "the specification of the atmospheric state at the central facility be accomplished from the combined Raman lidar and RASS. The ARM Program must plan on a rapid implementation of these remote sensing technologies." Further contributing to this specification will be temperature and humidity profiles to be generated routinely from AERI instrumentation at the central facility. The vigorous pursuit of this exciting opportunity would place the ARM Program in the international vanguard by diminishing the dependence of the atmospheric science community on the radiosonde for thermodynamic profiling of the troposphere. Full realization of this opportunity will require improved wind profiler observations. Contributing toward meeting this goal will be a series of three planned Water Vapor IOPs, the first of which will occur in September 1996. During these IOPs, the tropospheric water vapor profile will be intensively quantified, especially in the lowest layers, by using a full range of state-of-the-science instrumentation (e.g., a second Raman lidar and a second MWR), a tethersonde system, additional sensors on the 60-m tower at the 25-m level, fixed-sensor temperature, relative humidity, and surface pressure measurements near the BBSS launch point.

Additional development of the central facility will enhance its ability to monitor land-atmosphere interactions that contribute to cloud development and affect cloud characteristics. For example, the expected improved performance of the ECOR system there will permit a more complete characterization of the turbulent transfers of sensible heat and moisture. Characterization of the latter will also benefit from the additional information that will accrue from the use of scintillometers to measure sensible heat flux directly during the planned February-June 1996 Sensible Heat Flux IOP. The EBBR-based turbulent fluxes currently estimated for the central cluster are representative of the pasture conditions, whereas the direct ECOR measurements are characteristic of the wheat fields at the central facility. In addition, the delivery of the portable ECOR system in early 1996 will establish a capability to compare independent flux measurements by a single system. The expected addition of instrumentation to measure photosynthetically active radiation and UV-B radiation will provide the basis for supporting probable future ecological studies capitalizing on the other ARM CART instrumentation.

By mid 1996, the basis for the spatial integration of the turbulent and radiative fluxes over the entire SGP CART site will have been firmly established through the completion (according to their original design) of all but 1 of the 23 extended facilities. The remaining extended facility (the Okmulgee forested site) should be completed in early 1997. All extended facilities are being equipped with recently calibrated SIROS units and EBBR or ECOR systems. Beginning in January 1996 and extending through mid 1997, all extended facilities are being enhanced through the addition of SWATS. The SWATS data will contribute to completing the characterization of the land-atmosphere interactions that form the context for surface heat exchanges. Furthermore, approximately 40 additional, identical SWATS systems will be installed at Oklahoma Mesonet (OKM) sites within the SGP CART site domain during a two-year period beginning in mid 1996. The capability for monitoring of land-atmosphere interactions will be further enhanced during 1996 with the establishment and operation of three ARM intermediate facilities containing 915-MHz profilers with RASS, which will be used to quantify structures and processes in the planetary boundary layer.

The SGP CART site activities during the rest of 1996 and 1997 will capitalize on the late 1995 installation of the aerosol instrumentation and the RCF. The data from the associated suite of aerosol instruments will fill a significant gap in the specification of the radiative state of the near-surface atmosphere. The establishment of the RCF is a key element in the total quality control effort addressing the wide variety of radiometers at the central facility. Establishment of the RCF will be accompanied during 1996 by the development and implementation of the comprehensive integrated calibration plan that is required as the SGP CART site moves from the establishment of routine operations to the maintenance of routine operations, with inherent instrument-aging problems.

During the latter half of 1996 and 1997, the SGP CART site observational capabilities will be further enhanced as a result of ongoing interactions between the ARM Program and several other federal and state research programs having an interest in the SGP CART site. These interactions, which now particularly involve the GCIP component of GEWEX, have already resulted in the formation and functioning of a Joint ARM-GCIP-ISLSCP Working Group (on which ARM is represented by C. Doran, R.G. Ellingson, and P.J. Lamb), the funding by GCIP of additional SGP CART radiosonde observations during August 1994, and the implementation during the next 18 months of the SWATS (partially funded by GCIP) at the SGP CART site extended facilities. The joint Working Group will be concerned with suggesting observational strategies for the SGP CART site for the rest of 1996 and 1997. Beyond that, the Working Group will benefit all three programs by fostering the most cost-effective and efficient operations program possible among them. The Working Group is expected to meet twice annually in the foreseeable future. Interactions with the OKM, which has been an important source of external data for the SGP for several years, are expected to increase with the OKM's parallel deployment of approximately 40 SWATS systems.

The integration of ARM unmanned aerospace vehicle (UAV) operations into the SGP CART site scientific mission was initiated successfully during the April 1994 IOP, which used a small UAV (GNAT) that can ascend only to 6.7 km (~22,000 ft). However, delays in developing, testing, and gaining operational approval for the larger UAVs needed for radiation measurements at higher elevation have precluded their subsequent use over the SGP CART site. Manned aircraft are used instead, as during the ARESE IOP. The hope is that this situation will be rectified in the near future, permitting the valuable operation of UAV-mounted radiation instruments over the SGP CART site during the second half of 1996 and 1997. Such operational activities would likely be crucial to any focused follow-up to the fall 1995 ARESE IOP which, if needed, would occur during July 1996-December 1997. All UAV operations will be supported by climatological analyses by the SST of historical cloud and wind data for the SGP vicinity.

By July 1996, the scientific operation of the SGP CART site will have begun to benefit significantly from guidance provided by the SAC. This dividend is likely to grow during the following 18 months. The fundamental role of the SAC is to ensure that the operation of the site addresses the goals and objectives of the ARM Program (soon to be published in a formal *Science Plan*) to the fullest possible extent, including through successful adaptation to changing circumstances and opportunities. Such performance will ensure that the flows of data to the Science team members are appropriate to their needs, of consistently high quality, and as continuous as possible. Because the membership of the SAC is divided approximately equally between Science Team members and nonmembers, its guidance reflects both the inherently more parochial concerns of the Science Team members and the broader global-change perspective of the others. The recommendations from the November 1995 SAC meeting will be received during this six-month period, during which the SAC will likely reconvene at the University of Oklahoma for a more in-depth review of the Site Scientist's research program. Thus, from mid 1996 onward, the SAC guidance will have its greatest potential effect on the scientific mission of the SGP CART site. This fact, coupled with the anticipated completion of the site by mid 1996, should result in optimal operation of this ARM locale with respect to the goals and objectives of the overall ARM Program during the second half of 1996 and 1997.

8 REFERENCES

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APPENDIX A:

ACQUISITION AND DEPLOYMENT
OF INSTRUMENTS

TABLE A.1 Status of Instrument Acquisition and Deployment on December 31, 1995[a]

Instrument	Mentor	Ordered	Delivered	Central Facility Installation/ Acceptance	Extended Facility Installation/ Acceptance	Boundary Facility Installation/ Acceptance	Comment
WSI	Thorne	Done	Done	Done	None planned	None planned	An additional WSI will be installed at an auxiliary facility in 1996.
MWR	Liljegren	Done	Done	Done	None planned	Done	—
IR thermometer	Liljegren	Done	1 unit; 2 more in 1996	2/96	None planned	None planned	For use with the MWR.
BBSS	Lesht	Done	Done	Done	None planned	Done	—
EBBR	Cook	Done	Partial	Done	10 units installed; 3 more in 1996	None planned	Instrument changeouts for calibration implemented summer 1995.
915-MHz RASS	Coulter	Done	1 unit; 3 more in 1996	Done	None planned	None planned	Additional units to be placed midway between central and boundary facilities.
50-MHz RASS	Coulter	Done	Done	Done	None planned	None planned	—
SMOS	Hart	Done	Done	Done	12 units installed; 3 more in 1996	None planned	—
BLC	Campbell	Done	Done	Done	None planned	None planned	—
MPL	Griffin	Done	Done	4/96	None planned	None planned	—
Raman lidar	Goldsmith	Done	Done	Summer 1996	None planned	None planned	—
Calibration facility	Stoffel	Done	4/96	5/96	None planned	None planned	—
60-m tower	Cook	Done	Done	Done	None planned	None planned	—

TABLE A.1 (Cont.)

Instrument	Mentor	Ordered	Delivered	Central Facility Installation/ Acceptance	Extended Facility Installation/ Acceptance	Boundary Facility Installation/ Acceptance	Comment
25-m-level temperature and relative humidity on 60-m tower	Cook	Done	1 unit; 1 more in 1996	2/96	None planned	None planned	—
ECOR	Hart, Cook	Done	Done	Done	4 installed; 8 more in summer 1996	None planned	—
SWATS	Schneider	Done	Partial	1 installed in fall 1995	7 installed in fall 1995; 15 more by spring 1997	None planned	—
Aerosols							
Manifold sample system	Leifer	Done	Done	Done	None planned	None planned	—
Ozone monitor	Leifer	Done	Done	Done	None planned	None planned	—
Optical absorption system	Leifer	Done	Done	Done	None planned	None planned	—
3-λ integrating nephelometer	Leifer	Done	Done	Done	None planned	None planned	—
1-λ integrating nephelometer	Leifer	Done	Done	Done	None planned	None planned	—
Optical particle counter	Leifer	Done	Done	Done	None planned	None planned	—
Condensation particle counter	Leifer	Done	Done	Done	None planned	None planned	—
Broadband Radiometers: SIROS							
MFRSR	Schmelzer, Larson	Done	Partial	Done	18 installed; 5 more in 1996	None planned	—

TABLE A.1 (Cont.)

Instrument	Mentor	Ordered	Delivered	Central Facility Installation/ Acceptance	Extended Facility Installation/ Acceptance	Boundary Facility Installation/ Acceptance	Comment
Broadband Radiometers: SIROS (Cont.)							
Broadband radiometer loaners (ARM BSRN)	DeLuisi	Done	Done	Done	None planned	None planned	QME planned to compare ARM BSRN with SIROS.
Pyranometer (ventilated)	DeLuisi	Done	Partial	Done	17 installed; 5 more in 1996	None planned	—
Pyranometer (upwelling 10 m)	DeLuisi	Done	Partial	Done	17 installed; 5 more in 1996	None planned	—
Shaded pyranometer (ventilated)	DeLuisi	Done	Partial	Done	17 installed; 5 more in 1996	None planned	SciTec trackers and shading assemblies in use.
Pyrgeometer (shaded and ventilated)	DeLuisi	Done	Partial	Done	17 installed; 5 more in 1996	None planned	SciTec trackers and shading assemblies in use.
Pyrgeometer (upwelling 10 m)	DeLuisi	Done	Partial	Done	17 installed; 5 more in 1996	None planned	—
Pyrheliometers (NIP)	DeLuisi	Done	Partial	Done	17 installed; 5 more in 1996	None planned	SciTec trackers and shading assemblies in use.
Other Radiometric Instruments							
UV-B sensor	DeLuisi	Done	Done	6/96	None planned	None planned	—
PAR	DeLuisi	Done	Done	6/96	None planned	None planned	—
Pyranometer for 60-m tower	DeLuisi	Done	Done	Done	None planned	None planned	—
Pyrgeometer for 60-m tower	DeLuisi	Done	Done	Done	None planned	None planned	—
UV spectrometer	IDP/SUNY Albany	IDP in progress	In progress	In progress	None planned	None planned	—

TABLE A.1 (Cont.)

Instrument	Mentor	Ordered	Delivered	Central Facility Installation/ Acceptance	Extended Facility Installation/ Acceptance	Boundary Facility Installation/ Acceptance	Comment
Other Radiometric Instruments (Cont.)							
Rotating shadowband spectrometer	IDP/SUNY Albany	IDP in progress	In progress	In progress	None planned	None planned	—
AERI	Griffin, Best	In progress	Partial	Done	None planned	4 in fall 1996	First boundary facility installation to occur at Vici.
AERI X	Griffin, Murcray	No	No	Summer 1996	None planned	None planned	—
SORTI	Griffin, Murcray	In progress	Winter 1996	Winter 1996	None planned	None planned	—
Special IR broadband radiometer	None assigned	None	Unknown — unmet measure-ment	Unknown	None planned	None planned	—
MFR for upwelling at 10 m and 25 m	Schmelzer, Larson	Done	Done	Done	None planned	None planned	—

[a] AERI, atmospherically emitted radiance interferometer; BBSS, balloon-borne sounding system; BLC, Belfort laser ceilometer; BSRN, Broadband Solar Radiation Network; EBBR, energy balance Bowen ratio; ECOR, eddy correlation; IDP, Instrument Development Program; IR, infrared; MFR, multifilter radiometer; MFRSR, multifilter rotating shadowband radiometer; MPL, micropulse lidar; MWR, microwave radiometer; NIP, normal-incidence pyrheliometer; PAR, photosynthetically active radiometer; QME, quality measurement experiment; RASS, radio acoustic sounding system; SIROS, solar and infrared radiation observing system; SMOS, surface meteorological observation station; SORTI, solar radiance transmission interferometer; SUNY, State University of New York; SWATS, soil water and temperature system; UV, ultraviolet; WSI, whole-sky imager.

TABLE A.2 Status of Radiometric Calibration Facility on December 31, 1995

Component	Mentor	Procurement Status	Delivery	Site Installation/ Acceptance	Comments
Calibration trailer (shell)	Stoffel	Done	Done	Installed	Not equipped
Reference spectroradiometer	Cannon	Done	To NREL[a]	Winter 1996	Response: 300-1100 nm
Extended-wavelength spectroradiometer	Cannon	On hold	TBD[b]	TBD	Response: 300-3000 nm
Site reference cavity radiometer	Stoffel	Done	To NREL	Winter 1996	NREL calibration checks, fall 1993 and fall 1994
Program reference cavity radiometer	Stoffel	Done	To NREL	Accepted	NREL calibration checks, fall 1993 and fall 1994; primary location, NREL
Site working-standard cavity radiometer	Stoffel	Done	To NREL	Winter 1996	NREL calibration checks, fall 1993 and fall 1994; window installed
Control computer for cavity radiometers	Stoffel	Done	To NREL	Winter 1996	—
Atmospheric optical calibration system/reference sunphotometer	Cannon	On hold	TBD	TBD	Part of spectral capability
Automatic solar trackers for direct and diffuse solar radiation	Stoffel	Done	To NREL	Winter 1996	—
Large solar tracker	Stoffel	On hold	TBD	TBD	For spectral measurements
Reference diffuse pyranometers	Stoffel	Done	To NREL	Winter 1996	—
Working standard pyranometers, pyrheliometers, and pyrgometers	Stoffel	Done	Winter 1996	Winter 1996	Control and measurement radiometers; assurance units
Automatic solar trackers for pyrgeometers	Stoffel	Done	Winter 1996	Winter 1996	—
Tracker controller computer	Stoffel	Done	Winter 1996	Winter 1996	—
Power supply for trackers	Stoffel	Done	Winter 1996	Winter 1996	—
Silicon pyranometers and pyrheliometers	Stoffel	Done	To NREL	Winter 1996	—

TABLE A.2 (Cont.)

Component	Mentor	Procurement Status	Delivery	Site Installation/ Acceptance	Comments
NIST standard lamps[c]	Stoffel	Done	Done	TBD	At NREL
Controlled current source for lamps	Stoffel	On hold	TBD	TBD	Control NIST lamps
Reference blackbody cavities	Stoffel	Specifications to be written; might be fabricated at NREL	Winter 1996	TBD	—
Optical breadboard system	Stoffel	On hold	TBD	TBD	Specifications complete
Data acquisition system for solar radiometry	Stoffel	Done	Winter 1996	Winter 1996	Functional tests completed at NREL May 1995
Additional items for data acquisition for solar radiometers	Stoffel	Done	To NREL	Winter 1996	—
Blackbody circulators	Stoffel	Done	To NREL	Winter 1996	—
Master computer system	Stoffel	Specifications to be written	Winter 1996	Spring 1996	—
Inclinometer with power supply	Stoffel	Specifications to be written	Winter 1996	Spring 1996	—
Electronics test and calibration gear	Stoffel	Specifications to be written	Winter 1996	Spring 1996	—

[a] NREL, National Renewable Energy Laboratory.

[b] TBD, to be determined.

[c] NIST, National Institute of Standards and Technology.

TABLE A.3 Future and Potential Instruments[a,b]

Instrument	IDP Investigator/Mentor	Procurement	IDP Testing
Ultraviolet spectroradiometer[c]	Harrison	No	Fall 1996
Rotating shadowband spectrometer[c]	Michalsky, Harrison	No	Fall 1996
SORTI	Murcray, Griffin	Summer 1995	Winter 1996
Net radiometric profiler	Whiteman	No	Not scheduled yet
Millimeter cloud radar	Moran, Widener	SOW, fall 1994	Fall 1996
Passive microwave water vapor profiler[c]	Unknown	Unknown	Unknown
Temperature and relative humidity at 25-m level on central facility 60-m tower	—	Fall 1995	Winter 1996
Ceilometers at SGP boundary facilities[c]	Unknown	Unknown	Unknown
Leaf area index sensors at extended facilities[c]	Unknown	Unknown	Unknown
BBSS upgrade	Lesht	Early 1996	1996
Zenith sky radiance (near-IR) instrument[c]	Wiscombe	Unknown	Unknown
Optical transmissometer[c]	Wiscombe	Unknown	Unknown
Sunphotometer at SGP central facility[c]	Unknown	Unknown	Unknown
PARABOLA (for surface bidirectional reflectance)[c]	Unknown	Unknown	Unknown
Valero radiometers[c]	Valero	1995	Fall 1995-1996

[a] Includes IDP instruments.

[b] Abbreviations: BBSS, balloon-borne sounding system; IDP, Instrument Development Program; IR, infrared; PARABOLA, portable apparatus for rapid acquisition of bidirectional observations of the land and the atmosphere; SGP, Southern Great Plains; SORTI, solar radiance transmission interferometer; SOW, statement of work.

[c] Potential candidate.

APPENDIX B:

OBSERVATIONS, MEASUREMENTS, AND EXTERNAL DATA

TABLE B.1 CART Observation Status on December 31, 1995[a]

Observation	Platform	Comments
From the BBSS		
Sonde temperature profile	sgpsondewrpnC1.al	Available[b]
Sonde relative humidity profile	sgpsondewrpnC1.al	Available
Sonde pressure profile	sgpsondewrpnC1.al	Available
Sonde wind speed profile	sgpsondewrpnC1.al	Available
Sonde wind direction profile	sgpsondewrpnC1.al	Available
Recalculation of research mode pressure, temperature, and humidity without ground check applied to data for the period 4/8/94 to 5/20/94	DsgpsondeptucalcC1.c1 DsgpsondeptucalcB1.c1 DsgpsondeptucalcB4.c1 DsgpsondeptucalcB5.c1	Available Available Available Available
Recalculation of research mode pressure, temperature, and humidity with ground check applied to data for the period 4/8/94 to 5/20/94	DsgpsondenogcptucalcC1.c1 DsgpsondenogcptucalcB1.c1 DsgpsondenogcptucalcB4.c1 DsgpsondenogcptucalcB5.c1	Available Available Available Available
Removal of ground checks from nominal pressure, temperature, and humidity variables for the period 5/21/94 to 8/3/94	DsgpsondenogcwrpnC1.c1 DsgpsondenogcwrpnB1.c1 DsgpsondenogcwrpnB4.c1 DsgpsondenogcwrpnB5.c1	Available Available Available Available
From the MWR		
Column-integrated precipitable water vapor	sgpmwrlosC1.al	Available
Column-integrated liquid water path	sgpmwrlosC1.al	Available
23.8-GHz brightness temperature	sgpmwrlosC1.al	Available
31.4-GHz brightness temperature	sgpmwrlosC1.al	Available
IR (9.5-11.5 µm) sky temperature	sgpmwrlosC1.al	Available
From the AERI		
Wave number (520-1800 cm^{-1})	sgpaerich1C1.al	Available
Mean IR radiance spectra ensemble	sgpaerich1C1.al	Available
Standard deviation of spectra ensemble	sgpaerich1C1.al	Available
Wave number (1800-2725 cm^{-1})	sgpaerich1C1.a1	Available
Mean IR radiance spectra ensemble	sgpaerich1C1.al	Available
Standard deviation of spectra ensemble	sgpaerich1C1.al	Available
Mean IR radiance at 675-680, 700-705, 985-990, 2295-2300, 2282-2287, and 2510-2515 cm^{-1}	sgpaerisummaryC1.al	Available
Standard deviation of the radiance at 675-680, 700-705, 985-990, 2295-2300, 2282-2287, and 2510-2515 cm^{-1}	sgpaerisummaryC1.al	Available
Brightness temperature at 675-680, 700-705, 985-990, 2295-2300, 2282-2287, and 2510-2515 cm^{-1}	sgpaerisummaryC1.al	Available
From the EBBR (at Ten Sites)		
Sensible heat flux to surface	sgp30ebbrE4.al	Available
Latent heat flux to surface	sgp30ebbrE4.al	Available

TABLE B.1 (Cont.)

Observation	Platform	Comments
From the EBBR (at Ten Sites) (Cont.)		
Net radiation flux to surface	sgp30ebbrE4.al	Available
Soil heat flux to surface	sgp30ebbrE4.al	Available
Top and bottom temperatures	sgp30ebbrE4.al	Available
Top and bottom relative humidities	sgp30ebbrE4.al	Available
Top and bottom vapor pressures	sgp30ebbrE4.al	Available
Atmospheric pressure	sgp30ebbrE4.al	Available
Soil moistures at five points	sgp30ebbrE4.al	Available
Soil temperatures at five points	sgp30ebbrE4.al	Available
Scalar and resultant wind speeds	sgp30ebbrE4.al	Available
Mean and standard deviation of wind direction	sgp30ebbrE4.al	Available
From the SMOS (at Five Sites)		
Mean and standard deviation of wind speed	sgp30smosE4.al	Available
Mean and standard deviation of wind direction	sgp30smosE4.al	Available
Vector-averaged wind speed	sgp30smosE4.al	Available
Mean and standard deviation of temperature	sgp30smosE4.al	Available
Mean and standard deviation of relative humidity	sgp30smosE4.al	Available
Vapor pressure	sgp30smosE4.al	Available
Mean and standard deviation of barometric pressure	sgp30smosE4.al	Available
Snow depth	sgp30smosE4.al	Available
Precipitation total	sgp30smosE4.al	Available
From the ARM BSRN		
Direct beam-normal solar irradiance	sgpbsrnC1.a1	Available
Downwelling hemispheric diffuse solar irradiance	sgpbsrnC1.a1	Available
Downwelling hemispheric solar irradiance	sgpbsrnC1.a1	Available
Downwelling hemispheric IR irradiance	sgpbsrnC1.a1	Available
From the SIROS		
Direct beam-normal solar irradiance	sgpsirosE13.al	Available[c]
Downwelling diffuse solar irradiance	sgpsirosE13.al	Available[c]
Downwelling hemispheric solar irradiance	sgpsirosE13.al	Available[c]
Upwelling hemispheric solar irradiance	sgpsirosE13.al	Available[c]
Upwelling hemispheric IR irradiance	sgpsirosE13.al	Available[c]
Downwelling hemispheric IR irradiance	sgpsirosE13.al	Available[c]
Hemispheric downward solar irradiance (415, 500, 610, 665, 862, and 940 nm)	sgpsirosE13.al	Available[c]
Hemispheric downward total solar irradiance	sgpsirosE13.al	Available[c]
Diffuse hemispheric downward solar irradiance (415, 500, 610, 665, 862, and 940 nm)	sgpsirosE13.al	Available[c]
Diffuse hemispheric downward total solar irradiance	sgpsirosE13.al	Available[c]
Direct beam-normal solar irradiance (415, 500, 610, 665, 862, and 940 nm)	sgpsirosE13.al	Available[c]
Direct beam-normal total solar irradiance	sgpsirosE13.al	Available[c]

TABLE B.1 (Cont.)

Observation	Platform	Comments
From the BLC		
Cloud base height	sgpblcC1.c1	Available
From the Profiling Radars		
915-MHz wind speed profile	sgp915rwpwindC1.a2	Available[c]
915-MHz wind direction profile	sgp915rwpwindC1.a2	Available[c]
915-MHz virtual temperature profile	sgp915rwptempC1.a2	Available[c]
50-MHz wind speed profile	sgp50rwpwindC1.a2	Available[c]
50-MHz wind direction profile	sgp50rwpwindC1.a2	Available[c]
50-MHz virtual temperature profile	sgp50rwptempC1.a2	Available[c]
Other Systems		
Interim WSI	sgpwsicloudC1.c1	Available[c]
60-m tower temperature and relative humidity	sgp30twr21x.C1 sgp1twr21x.C1 sgp1440twr21x.C1	Available
Upwelling MFR at 10 m (tower)	Dsgpmfr10mC1.a1	Available[c]
Upwelling MFR, precision solar pyranometer, and precision IR radiometer at 25 m	Dsgpmfr25mC1.a1	Available[c]
From Future Instruments		
Cloud base height (MPL)	DsgpmplcbhC1.c1	IDP testing in 1995
Ultraviolet spectral radiometer	—	IDP testing in 1995

[a] AERI, atmospherically emitted radiance interferometer; BBSS, balloon-borne sounding system; BLC, Belfort laser ceilometer; BSRN, Broadband Solar Radiation Network; EBBR, energy balance Bowen ratio; IR, infrared; MFR, multifilter radiometer; MPL, micropulse lidar; MWR, microwave radiometer; SIROS, solar and infrared radiation observing system; SMOS, surface meteorological observation station; WSI, whole-sky imager.

[b] "Available" means that an instrument is in the field producing some level of data. Normally, the data have been fully released by the instrument mentor.

[c] Beta release to selected users.

TABLE B.2 CART Measurement Status on December 31, 1995[a]

Measurement	Platform	Comments
From the ARM BSRN		
Direct beam-normal solar irradiance	sgpbsrncalcC1.c1	Available[b]
Calculated downward hemispheric diffuse solar irradiance	sgpbsrncalcC1.c1	Available
Downwelling hemispheric solar irradiance	sgpbsrncalcC1.c1	Available
Solar zenith angle used in calculation	sgpbsrncalcC1.c1	Available
From the SIROS		
Optical depth (spectrally resolved)	DsgpsirosdepthC1.a1	Available
Solar constant (spectrally resolved)		
From the MWR		
Average (5-min) column-integrated water vapor	sgp5mwravgC1.c1	Available
Average (5-min) column-integrated liquid water	sgp5mwravgC1.c1	Available
Average (5-min) blackbody equivalent brightness temperature	sgp5mwravgC1.c1	Available
Water vapor density profile	sgpmwrprofC1.c1	Available
From the SIROS MFRSR		
Optical depth (415, 500, 610, 665, 862, and 940 nm)	sgpsirosopdepthC1.c1	Available
Solar constant (415, 500, 610, 665, 862, and 940 nm)	sgpsirosopdepthC1.c1	Available
Optical depth calculation standard error (415, 500, 610, 665, 862, and 940 nm)	sgpsirosopdepthC1.c1	Available
From Science Team Algorithms		
Reflected solar flux at top of atmosphere (TOA) (Cess algorithm)	toa-refflx	Available
Input for LBLRTM	lblrtm.input	Available
Output from LBLRTM (IR spectral irradiance at 520-3020 cm^{-1})	lblrtm.output	Available
Difference of observations and calculations of IR irradiances	qme-aerilbldiff	Available
Map of wave number to physical process	qme-MLSspecmap	Available
Statistical summary of radiance residuals	qme-aerilbl	Available
Statistical summary of hourly AERI radiance	qme-aerimeans	Available

[a] AERI, atmospherically emitted radiance interferometer; BSRN, Broadband Solar Radiation Network; IR, infrared; LBLRTM, line-by-line radiative transfer model; MFRSR, multifilter rotating shadowband radiometer; MWR, microwave radiometer; SIROS, solar and infrared radiation observing system; TOA, top of atmosphere.

[b] Available means that an instrument is in the field producing some level of data; however, the data may not have been released by the instrument mentor or the Experiment Center and thus may not be available to the Science Team members.

TABLE B.3 CART External Data Status on December 31, 1995[a]

Measurement	Platform	Comments
From Satellites		
AVHRR channel 1 "albedo," channel 2 "albedo," channel 3 brightness temperature, channel 4 brightness temperature, channel 5 brightness temperature, satellite-solar azimuth angle, satellite zenith angle, and solar zenith angle	sgpavhrrnnX1.a1[b]	Available
AVHRR radiances: channel 3 calibrated radiances, channel 4 calibrated radiances, channel 5 calibrated radiances	sgpavhrrnnradX1.a1	Available
AVHRR coastlines and rivers	avhrr_sgp.rivers	Available
AVHRR state lines	avhrr_sgp.state_lines	Available
AVHRR annotated latitude and longitude	avhrr_sgp.lat_lon	Available
GOES-8[c] visible: visible channel "albedo," satellite-solar azimuth angle, satellite zenith angle, and solar zenith angle	sgpgoes8visX1.a1	Available
GOES-8 channel 1 "albedo," channel 2 brightness temperature, channel 4 brightness temperature, channel 5 brightness temperature, satellite-solar azimuth angle, satellite zenith angle, and solar zenith angle	sgpgoes8X1.a1	Available
GOES (4-km) coastlines and rivers	goes_ir_sgp.rivers	Available
GOES (4-km) state lines	goes_ir_sgp.state_lines	Available
GOES (4-km) annotated latitude and longitude	goes_ir_sgp.lat_lon	Available
GOES (1-km) coastlines and rivers	goes_vis_sgp.rivers	Available
GOES (1-km) state lines	goes_vis_sgp.state_lines	Available
GOES (1-km) annotated latitude and longitude	goes_vis_sgp.lat_lon	Available
From GOES Data		
GOES derived products: cloud amount (low, medium, and high), visible optical depth (low, medium, and high), IR optical depth (low, medium, and high), emissivity (low, medium, and high), cloud center height (low, medium, and high), cloud top height (low, medium, and high), cloud temperature (low, medium, and high), cloud thickness (low, medium, and high), reflectance (low, medium, and high), albedo (low, medium, and high), cloud center temperature (low, medium, and high), cloud top temperature (low, medium, and high), visible optical depth standard deviation (low, medium, and high), cloud center temperature standard deviation (low, medium, and high), broadband longwave flux (clear sky and total), narrowband IR flux (clear sky and total), broadband shortwave albedo (clear sky and total), narrowband visible albedo (clear sky and total), clear temperature, clear temperature standard deviation, narrowband visible albedo standard deviation, clear visible reflectance, and solar zenith angle	sgpgoes7minnisX1.c1 (covers area at 32-42° N, with 0.5° resolution) sgpgoes7minnis_acfX1.c1 (a 3 × 3 array of 0.3 resolution pixels centered on central facility)	Available[d]

TABLE B.3 (Cont.)

Measurement	Platform	Comments
From the Forecast Systems Laboratory MAPS Model		
Gridded meteorological fields (eight daily) of height, temperature, relative humidity, and horizontal wind components, every 25 kPa from the surface to 100 kPa, covering most of North America (subsets also available)	sgpallmaps60X1.c1	Available
Gridded meteorological fields (eight daily) of height, temperature, relative humidity, and horizontal wind components, every 25 kPa from the surface to 100 kPa, covering most of the SGP CART site	sgpmaps60X1.c1	Available
Derived variables from MAPS data, similar to those in ngm250derived	sgpmaps60derivX1.c1	Available
From the Arkansas-Red River Basin Forecast Center		
Hourly precipitation estimates for an area much larger than the SGP CART site, at 4-km resolution	sgpabrfcpcpX1.c1	Available
From the National Meteorological Center ETA Model		
Gridded meteorological fields (four daily) of height, temperature, relative humidity, and horizontal wind components, every 50 kPa from the surface to 100 kPa, covering most of North America (subsets also available)	sgpalleta90X1.c1	Available
Gridded meteorological fields (four daily) of height, temperature, relative humidity, and horizontal wind components, every 50 kPa from the surface to 100 kPa, covering most of the SGP CART site	sgpeta90X1.c1	Available
Horizontally averaged values, derived from eta90 data, of surface pressure (reduced to sea level), tropopause pressure, and surface temperature	eta90derived	Available
Slab-averaged vertical profiles, derived from eta90 data, of temperature (T), -(u*dT/dx + v*dT/dy), water vapor mixing ratio (q), -(u*dq/dx + v*dq/dy), horizontal wind components (u and v), (du/dx + dv/dy), -(u*du/dx + v*du/dy), - (u*dv/dx + v*dv/dy), and geopotential height (Z), dZ/dx, dZ/dy, d2T/dx2, d2T/dy2, d2q/dx2, d2q/dy2, d2u/dx2, d2u/dy2, d2v/dx2, d2v/dy2	eta90derived	Available
From the NOAA Wind Profiler Demonstration Network		
Profile of hourly consensus wind components	sgp60wpdnwndsX1.b1	Available
Profile of 6-min moments of wind components	sgp06wpdnmmtsX1.a1	Available
Hourly surface observations	sgp60wpdnsurfX1.b1	Available
From the NWS		
Surface hourly observations	sgpnwssurfX1.00	Available
Upper air observations	sgpnwsupaX1.00	Available

TABLE B.3 (Cont.)

Measurement	Platform	Comments
From the Kansas Surface Mesonetwork		
Daily observations of maximum air temperature, minimum air temperature, total precipitation, total solar radiation, maximum 5-cm soil temperature, minimum 5-cm soil temperature, maximum 10-cm soil temperature, minimum 10-cm soil temperature, average relative humidity, maximum relative humidity, minimum relative humidity, mean wind speed, resultant wind speed, resultant direction, standard deviation of direction, and maximum (fastest minute) wind speed	sgp1440ksumesoX1.a1	Available
Hourly observations of average temperature, average relative humidity, average wind speed, average wind direction, average solar radiation, total precipitation, average 10-m temperature	sgp60ksumesoX1.a1	Available
From the Oklahoma Mesonetwork		
Observations of air temperature, relative humidity, wind direction, wind speed, total solar radiance, total rainfall, and 5- and 10-cm soil temperatures (15-min average)	sgp15okmX0.a0	Available
Observations of air temperature, relative humidity, wind direction, wind speed, total solar radiance, total rainfall, and 5- and 10-cm soil temperatures (5-min average)	sgp05okmX0.a0	Available

[a] AVHRR, advanced very-high-resolution radiometer; GOES, geostationary orbiting Earth satellite; IR, infrared; MAPS, Mesoscale Analysis and Prediction System; NOAA, National Oceanic and Atmospheric Administration; NWS, National Weather Service.

[b] The "nn" in the "avhrnn" file name is the sequence number for the NOAA satellite (e.g., NOAA-12 or NOAA-14).

[c] The GOES infrared channels may vary with the schedule for use at a particular time.

[d] Available over the World Wide Web from NASA (National Aeronautics and Space Administration) Langley ARM home page: http://albedo.larc.nasa.gov:1123/arm.html

TABLE B.4 CART Measurements and External Data Expected to Be in Place by December 31, 1995[a]

Radiation

Point AERI downwelling IR radiance
Point MFRSR global, diffuse, direct solar narrowband irradiance
Point pyrgeometer downwelling global IR irradiance
Point pyrgeometer upwelling global IR irradiance
Point pyranometer downwelling global solar irradiance
Point pyranometer upwelling global solar irradiance
Central downwelling 10-µm irradiance
Reflected solar flux at top of atmosphere
Point IR (9.5-11.5 µm) sky temperature
Satellite clear-sky reflectance
Satellite clear-sky-equivalent blackbody temperature
AVHRR visible "albedo," narrowband radiances, and brightness temperatures[b]
VISSR atmospheric sounder visible "albedo," narrowband radiances, and brightness temperatures[c]
Site 2-D grid of surface downwelling solar radiative flux
Site 2-D grid of surface upwelling solar radiative flux
Site 2-D grid of surface downwelling IR radiative flux
Site 2-D grid of surface upwelling IR radiative flux
Site average surface downwelling solar radiative flux
Site average surface upwelling solar radiative flux
Site average surface downwelling IR radiative flux
Site average surface upwelling IR radiative flux

Temperature

Central sonde vertical profile of temperature
Boundary sonde vertical profile of temperature
NWS sonde vertical profile of temperature
Extended 3-D grid of temperature
Site vertical profile of slab-averaged temperature
Site vertical profile of slab-averaged advective temperature tendency
60-m tower temperature
25-m tower temperature

Pressure

Central sonde vertical profile of pressure
NWS sonde vertical profile of pressure
Extended 3-D grid of pressure
Extended 3-D grid of pressure surface heights
Site vertical profile of sonde-derived pressure gradient
Site vertical profile of RASS-derived pressure gradient

Water Vapor

Central inferred vertical profile of water vapor density
Central sonde vertical profile of relative humidity

TABLE B.4 (Cont.)

Water Vapor (Cont.)

Central sonde vertical profile of WVMR
NWS sonde vertical profile of relative humidity
Point MWR column-integrated "total precipitable" water vapor
Extended 3-D grid of WVMR
Site vertical profile of slab-averaged sonde WVMR
Site vertical profile of slab-averaged advective WVMR tendency
60-m tower relative humidity
25-m tower relative humidity

Winds and Dynamics

Central vertical profile of vertical wind components
Point sonde vertical profile of horizontal wind components
NWS sonde vertical profile of horizontal wind components
Extended 2-D grid of surface horizontal wind components
Extended 3-D grid of horizontal wind components
Site vertical profile of slab-averaged horizontal wind components
Site vertical profile of slab divergence of horizontal wind
Site vertical profile of slab-averaged advective momentum tendency
Site vertical profile of vertical velocity
Site vertical profile of geostrophic wind components

Trace Gases

Central surface ozone concentration

Aerosols

Central derived surface visibility
Central surface aerosol size distribution
Central surface aerosol absorption and scattering coefficient at 550 nm
Central vertical profile of ceilometer relative aerosol backscatter

Cloud Bulk Morphology and Distribution

Central ceilometer cloud base height
Central whole-sky image
Horizontal cloud distribution
Central fractional cloud cover
Cloud spacing
Cloud thickness
Site fractional cloud cover
Site cloud base height
Cloud top temperature (radiative)
Cloud base temperature (radiative)
NWS/USAF cloud fraction (by layer)
NWS/USAF cloud type (by layer)
NWS/USAF cloud base (by layer)
Cloud base height

TABLE B.4 (Cont.)

Cloud Bulk Morphology and Distribution (Cont.)

Satellite-derived cloud amount
Satellite-derived cloud top temperature
Satellite-derived cloud top height
Satellite-derived cloud center temperature
Satellite-derived cloud center height
Satellite-derived cloud thickness

Cloud Microphysics and Precipitation

Point MWR total cloud liquid water
Central vertical profile of phase of water
Point SMOS precipitation rate
Point NWS precipitation rate
Point Kansas Mesonet precipitation rate
Point Oklahoma Mesonet precipitation rate
Site 2-D grid of precipitation rate
Site total column cloud water

Cloud Optical Properties

Cloud albedo
Satellite-derived cloud reflectance
Satellite-derived cloud albedo
Satellite-derived visible optical depth
Satellite-derived IR optical depth
Satellite-derived IR emissivity
Satellite-derived narrowband IR flux
Satellite-derived broadband longwave flux

Clear-Sky Properties

Satellite-derived narrowband IR flux
Satellite-derived broadband longwave flux
Satellite-derived narrowband visible albedo
Satellite-derived broadband shortwave albedo
Satellite-derived albedo temperature

Near-Surface Meteorology

Point SMOS near-surface temperature
EBBR flux station near-surface temperature (two levels)
Point NWS near-surface temperature
Point Oklahoma Mesonet near-surface temperature
Point Kansas Mesonet near-surface temperature
Point SMOS near-surface pressure
EBBR flux station near-surface pressure
Point NWS near-surface pressure
Point Oklahoma Mesonet near-surface pressure
Point Kansas Mesonet near-surface pressure

TABLE B.4 (Cont.)

Near-Surface Meteorology (Cont.)

Point SMOS near-surface relative humidity
EBBR flux station near-surface relative humidity (two levels)
Point NWS near-surface relative humidity
Point Oklahoma Mesonet near-surface relative humidity
Point Kansas Mesonet near-surface relative humidity
Point SMOS 10-m horizontal wind components
EBBR flux station 2-m horizontal wind components
Point NWS near-surface horizontal wind components
Point Oklahoma Mesonet near-surface horizontal wind components
Point Kansas Mesonet near-surface horizontal wind components
Extended 2-D grid of near-surface temperature
Extended 2-D grid of near-surface pressure
Extended 2-D grid of near-surface WVMR
Site average near-surface temperature
Site average near-surface pressure
Site average near-surface WVMR
Site average near-surface horizontal wind components
Point-derived PBL depth
Central capping inversion depth
Site average PBL depth

Surface Fluxes

ECOR flux station surface sensible heat flux
ECOR flux station surface moisture flux
ECOR flux station surface momentum flux
EBBR surface net radiation flux
EBBR surface latent heat flux
EBBR surface sensible heat flux
EBBR soil heat flux
Site 2-D grid of surface sensible heat flux
Site 2-D grid of surface moisture flux
Site 2-D grid of surface momentum flux
Site average surface sensible heat flux
Site average surface moisture flux
Site average surface momentum flux

Surface Properties

Point-derived broadband surface albedo
EBBR soil moisture
Gridded surface conditions
Site 2-D grid of surface roughness
Site 2-D grid of surface albedo
Site average surface albedo
Site average surface roughness
Site ground surface type
Site average surface WVMR
Site average ground temperature

TABLE B.4 (Cont.)

Quality Measurements
Comparison of observed and calculated IR irradiance
Comparison of observed and calculated microwave brightness temperatures
Comparison of MWR and sonde precipitable water
Comparison of surface net radiation estimates
Comparison of surface heat flux estimates
Comparison of cloud base estimates

[a] AERI, atmospherically emitted radiance interferometer; AVHRR, advance very-high-resolution radiometer; EBBR, energy balance Bowen ratio; ECOR, eddy correlation; GOES, geostationary orbiting Earth satellite; IR, infrared; MFRSR, multifilter rotating shadowband radiometer; MWR, microwave radiometer; NWS, National Weather Service; PBL, planetary boundary layer; RASS, radio acoustic sounding system; SMOS, surface meteorological observation station; USAF, U.S. Air Force; VISSR, visible-IR spin-scan radiometer; WVMR, water vapor mixing ratio; 2-D, two-dimensional; 3-D, three-dimensional.

[b] On polar-orbiting satellites.

[c] On geostationary satellites (GOES).